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ENVIRONMENTAL IMPACT ASSESSMENT FOR BANNERMAN MINING RESOURCES' PROPOSED NEW WATER PIPELINE FROM THE BASE PUMPSTATION NEAR SWAKOPMUND TO THE ETANGO PROJECT TURN OFF FROM THE C28 ROAD

MARCH 2022

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DOCUMENT CONTROL

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ACRONYMS

ASEC	A. Speiser Environmental Consultants
BGR	German Federal Institute for Geo-science and Natural Resources
BID	Background Information Document
CBD	Central Business District
CV	Curriculum Vitae
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EAADT	estimated annual average daily traffic
EAP	Environmental Assessment Practitioner
EAPAN	Environmental Assessment Professionals Association of Namibia
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EQOS	Environmental Quality Objectives
IAPS	Interested and Affected Parties
MAWLR	Ministry of Agriculture, Water and Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
MME	Ministry Of Mines and Energy
MOHSS	Ministry of Health and Social Services
NNNP	Namib Naukluft National Park
PSD	particle size distribution
RA	Namibian Roads Authority
RUL	Rössing Uranium Limited
RUN	Reptile Uranium Namibia (Pty) Ltd
SEA	Strategic Environmental Assessment
SAIEA	Southern African Institute of Environmental Assessment
VKT/DAY	vehicle kilometers travelled per day

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1 INTRODUCTION

Bannerman Mining Resources (Namibia) (Pty) Ltd (Bannerman) has an Environmental Clearance Certificate (ECC2847) for the proposed mining and associated activities at the Etango Project. Bannerman is currently conducting a Definitive Feasibility Study for their Etango-8 Uranium Project. The Etango-8 Project is a 'smaller version' of the ultimate Etango Project, where the processing plant throughput is initially limited to 8 million tonnes of ore per year. The possible expansion to the ultimate Etango Project is however depended on market conditions.

Bannerman appointed A. Speiser Environmental Consultants (ASEC) to conduct an Environmental Impact Assessment (EIA) (including the development of an Environmental Management Plan (EMP)) for the proposed water pipeline section from the NamWater base pump station near Swakopmund to the Etango Project turn off from the C28 Road (refer to **Figure 1** for the location of this section of the pipeline), as this had not been covered in the previous / approved EIA. The remaining section of the pipeline from the C28 Road to the Etango Project area has already been assessed and approved as part of the Etango EIA (Etango Project: Linear Infrastructure Environmental Impact Assessment, Environmental Impact Report (March /April 2011), Environmental Resources Management (ERM)) conducted between 2007 and 2008 and finalized in 2011 (ECC1608) (see **Figure 1**, blue line). Bannerman therefore needs to apply for an ECC from the Ministry of Environment, Forestry and Tourism (MEFT) – Department of Environmental Affairs (DEA) for the construction of the first section of the pipeline, as described in **Section 7** of this EIA.

This application only applies to the construction / operation of the water pipeline and not to the water abstraction / supply. This will be as per agreement between Bannerman and NamWater.

Reptile Mineral Resources & Exploration commenced with an EIA application process for their Tumas Project and associated activities, which includes (amongst others) a proposed new water pipeline to the Tumas Project area. The Environmental Teams are working closely together on both EIA projects. Bannerman and Reptile Mineral Resources & Exploration (and Deep Yellow Ltd) are in discussion to consider the likelihood of constructing a combined pipeline for the relevant section. However, this will greatly depend on the possibility to align the projects, as well as economic factors, e.g. sourcing of funding to start mine construction at the same time. In this EIA it is however assumed that Bannerman will construct their own water pipeline and all assessments have thus taken this base case into account.

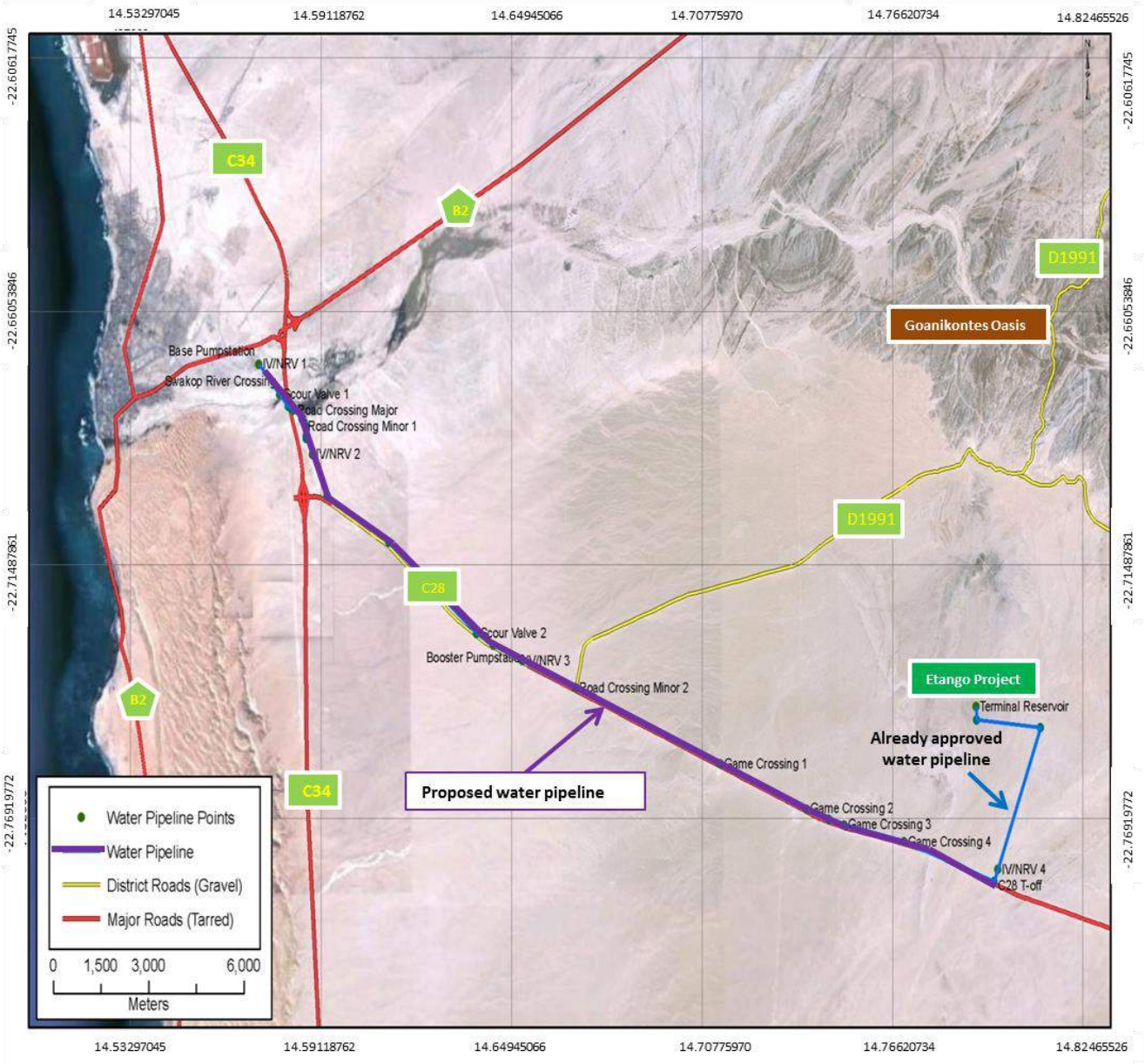


Figure 1: Location of the newly assessed water pipeline (purple) and already approved water pipeline (blue).

2 INTRODUCTION TO THE ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF THE WATER PIPELINE

EIAs are regulated by the MEFT (DEA) in terms of the Environmental Management Act, 7 of 2007. This Act was gazetted on 27 December 2007 (Government Gazette No. 3966). The List of Activities that may not be undertaken without an Environmental Clearance Certificate (ECC) and the EIA Regulations: Environmental Management Act, 2007 (Government Gazette No. 4878) were promulgated on 18 January 2012.

Below is a summary of the activity as listed in the Environmental Regulations from 2012, which is relevant to the proposed water pipeline construction:

10. INFRASTRUCTURE

10.1 The construction of-

(a) oil, water, gas and petrochemical and other bulk supply pipelines.

2.1 EIA process for the proposed water pipeline for the Etango Project

The main purpose of this report is to provide information relating to Bannerman's proposed water pipeline construction to supply water to the Etango Mine and to list the environmental aspects and impacts that are identified during the scoping process; to assess them; and to provide relevant management and mitigation measures to avoid or minimize the potential impacts (included in the EMP). The following specialist studies have been conducted:

- Fauna specialist study,
- Flora specialist study,
- Archaeology specialist study.

Please note that a 'full EIA' has been conducted for the Etango Project (Mine) by ERM in 2011 (Etango Project Environmental and Social Impact Assessment (ESIA)) and approved by MEFT:DEA. The ECC1608 was renewed as set out in the Environmental Act. The last renewal was granted in September 2021.

The EIA Scoping process and corresponding activities are outlined in **Table 1** below.

Table 1: EIA Scoping process.

Objectives	Corresponding activities
Scoping phase (including assessment of impacts) (October 2021 – March 2022)	
• Identify interested and/or affected parties (IAPs) and involve them in the EIA (scoping) process through information sharing. • List environmental issues associated with the project. • Provide a description of the affected environment. • Assessment of potential environmental impacts associated with the proposed project.	• Submission of Application Form No. 1 to the Ministry of Agriculture Water and Land Reform (MAWLR) as the Competent Authority. • Register the application on the MEFT online portal. • Identify government authorities and IAPs and notify them of the project and EIA process. • Email a Background Information Document (BID) to all IAPs on the

Objectives	Corresponding activities
• Compile an EMP with mitigation measures.	project EIA database. • IAP registration and initial comments period. • Compilation of Scoping (including impact assessment) Report and EMP. • Distribute Scoping Report and EMP to relevant authorities and IAPs for review. • Meetings with I&APs were done in February and early March 2022, where the study findings associated with the proposed new water pipeline were shared, during the review period of the EIA report. • Forward finalised Scoping Report and EMP with IAPs comments to MAWLR and MEFT for decision making.

2.3 Environmental Assessment Practitioner Team

ASEC is the independent firm of consultants appointed by Bannerman to undertake the EIA process. Alexandra Speiser, the project manager, has more than 20 years of relevant experience in environmental management, conducting/managing EIAs, compiling EMPs and implementing EMPs and Environmental Management Systems. Alexandra has a Master Degree in Geology/Paleontology and a Post-Master degree in Environmental Management. Alexandra is certified as a lead environmental practitioner and reviewer with the Environmental Assessment Professionals Association of Namibia (EAPAN). She is also member of the Chamber of Mines of Namibia and Chamber of Environment of Namibia.

Werner Petrick has twenty-three years of relevant experience in conducting/managing EIAs, compiling EMPs and implementing EMPs and Environmental Management Systems. Werner has a B. Eng (Civil) degree and a Master's degree in environmental management is certified as lead environmental practitioner and reviewer under the EAPAN.

The relevant curriculum vitae documentation is attached in **Appendix A**.

The environmental project team is outlined in **Table 2**.

Table 2: Environmental Project Team.

Team	Name	Designation	Tasks and roles	Company
Bannerman	Werner Ewald	Managing Director/ Project proponent	Responsible for the interface between Bannerman and the environmental team, and for ensuring implementation of the EIA / EMP outcomes.	Bannerman Mining Resources (Namibia) (Pty) Ltd
Project management	Alexandra Speiser	Project Manager	Management of the process, team members and other stakeholders. Report compilation. Review	ASEC

Team	Name	Designation	Tasks and roles	Company
	Werner Petrick	Project Management Assistant	Management of the process, team members and other stakeholders. Report review	Namisun
Specialist investigations	John Kinahan	Archaeologist	Conduct archaeological field study	QRS
	Antje Burke	Botanist	Conduct botanical field study	EnviroScience
	Peter Cunningham	Ecologist	Conduct vertebrate fauna field study	Environment and Wildlife Consulting Namibia

3 EIA PROCESS METHODOLOGY

3.1 Information collection

Various sources to identify the environmental issues associated with the water pipeline construction were used. The main sources of information for the preparation of this Scoping (including impact assessment) Report include:

- Project information were provided by Bannerman
- Specialist study including a site visit by Dr. J. Kinahan (archaeologist)
- Specialist study including a site visit by Dr. Antje Burke (flora)
- Specialist study including a site visit by Dr. Peter Cunningham (ecologist, vertebrate fauna)
- Literature research, including previous EIAs for the Langer Heinrich Uranium and Swakop Uranium pipelines

3.2 Scoping/Assessment Report

The main purpose of this Scoping/Assessment Report is to state which environmental aspects relating to the construction and operation of the water pipeline might have an impact on the environment, to assess them and to set out management and mitigation measures to avoid or reduce these impacts. **Table 3** outlines the Scoping Report requirements contained in Section 8 of the EIA Regulations under the Environmental Management Act, 7 of 2007. The table includes reference to the relevant sections in the report.

Table 3: Scoping report requirements stipulated in the EIA regulation.

Requirements for a Scoping Report in terms of the February 2012 regulations	Reference in report
(a) the curriculum vitae of the EAP who prepared the report;	Appendix A
(b) a description of the activity;	Section 7
(c) a description of the site on which the activity is undertaken and the location of the activity on the site	Section 7
(d) a description of the environment that may be affected by the proposed activity and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed listed activity;	Section 8
(e) an identification of laws and guidelines that have been considered in the preparation of the Scoping Report;	Section 5
(f) details of the public consultation process conducted in terms of regulation 7(1) in connection with the application, including - (i) the steps that were taken to notify potentially interested and affected parties of the proposed application; (ii) proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the proposed application have been displayed, placed or given; (iii) a list of all persons, organisations and organs of state that were registered in terms of regulation 22 as interested and affected parties in relation to the application; and (iv) a summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues;	Section 4 Appendix D, C, E
(g) a description of the need and desirability of the proposed listed activity and any identified alternatives to the proposed activity that are feasible and reasonable, including the advantages and disadvantages that the proposed activity or alternatives have on the	Section 6

Requirements for a Scoping Report in terms of the February 2012 regulations	Reference in report
environment and on the community that may be affected by the activity;	
(h) a description and assessment of the significance of any significant effects, including cumulative effects, that may occur as a result of the undertaking of the activity or identified alternatives or as a result of any construction, erection or decommissioning associated with the undertaking of the proposed listed activity;	Section 9
(i) terms of reference for the detailed assessment; and	
(j) a draft management plan, which includes - (i) information on any proposed management, mitigation, protection or remedial measures to be undertaken to address the effects on the environment that have been identified including objectives in respect of the rehabilitation of the environment and closure; (ii) as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of the activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and (iii) a description of the manner in which the applicant intends to modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation remedy the cause of pollution or degradation and migration of pollutants.	Appendix I

4 PUBLIC PARTICIPATION PROCESS

The public participation process for the construction and operation of the water pipeline aimed to ensure that all Interested and Affected Parties (IAPs) and/or organizations that might be affected by the proposed project were informed and could register their views and concerns. By consulting with IAPs the range of environmental issues to be considered in the EIA Report (including the assessment of impacts) has been given specific context and focus.

Included below is a summary of the people consulted, the process that was followed, and the issues that were identified.

4.1 Stakeholders

Table 4 provides a list of stakeholders to whom the Background Information Document (BID) (**Appendix B**) has been directly emailed. No further IAPs have contacted the EIA team to register as an IAP after the newspaper adverts had been placed on 12 and 19 October 2021. The detailed list of IAPs can be found in **Appendix C**.

Table 4: Stakeholder list

Organisations
Government – National, Regional & Local
Business and Commerce
Farmers
Industry
Industry associations
Tourism
Academic
Registered as an IAP:
Water-Solutions (RSA) Lund Consulting Engineers

4.2 Steps in the consultation process

Table 5 sets out the steps in the consultation process that were conducted during the EIA Scoping process:

Table 5: Consultation process with IAPs.

TASK	DESCRIPTION	DATE
Notification - regulatory authorities and IAPs		
IAP identification	See **Table 4 and the comprehensive list in Appendix C**	October 2021
Newspaper Advertisements	Block advertisements were placed as follows: • Allgemeine Zeitung • Republikein • Namibian Sun Copies of the advertisements are attached in **Appendix D**.	12 & 19 October 2021
Distribution of background information	BIDs were emailed to I&APs listed in **Table 4** on 12 October 2021. The purpose of the BID was to inform IAPs about the	October 2021

TASK	DESCRIPTION	DATE
document (BID)	proposed Project (i.e. relevant section of the bulk water supply pipeline to the Bannerman's proposed bulk water pipeline to the Etango Project, the EIA (Scoping) process being followed, potential environmental impacts identified by the Environmental Team and means of providing input to the EIA (Scoping) process. Attached to the BID was a registration and response form, which provided IAPs with an opportunity to submit their names, contact details and comments on the project. A copy of the BID is attached in **Appendix B**.	
Site notices	A site notice was placed at the entrance to the NNNP in January 2022 (**Appendix D**).	January 2022
IAP Study Focus Group Meetings	The EIA Focus Group Meetings with key stakeholders and I&APs EIA Scoping / Assessment Report. An advert was placed in the Republikein, Sun and Allgemeine Zeitung on 11 February 2022 (**Appendix E**) to announce the review period and Focus Group Meetings. IAPs were invited to contact ASEC or Bannerman should they wish to be part of one of the focus group meetings. Minutes can be found in **Appendix E**.	24 & 25 February 2022 and 01 &02 March 2022
Comments		
Comments and Responses	See **Table 7**	February/March 2022
Review of draft Scoping (including Impact Assessment) Report and EMP		
IAPs and authorities (excluding MEFT) review of Scoping Report and EMP	The EIA Scoping / Assessment Report (with EMP) has been distributed to all IAPs that are registered on the IAP database via e-mail. Authorities and IAPs have 21 working days to review the EIA documents and submit comments in writing to A. Speiser. The closing date for comments was 04 March 2022.	11 February to 04 March 2022
MEFT review of Scoping Report and EMP	A copy of the final Scoping / Assessment Report, including authority and IAP review comments, was delivered to MAWLR and MEFT on completion of the public review process, for their review and decision.	March 2022

4.3 Focus group meetings

Focus group meetings were scheduled on 24 and 25 February 2022 and 01 and 02 March 2022. **Table 6** lists the meetings. Minutes can be found in **Appendix E**. On 11 February 2022 an advert was placed informing IAPs about the review period and registration for focus group meetings.

Table 6: List of Focus Group Meetings.

Date	Organization
24 February 2022	Office of the Mayor of Swakopmund

24 February 2022	MAFT - Parks Authority Namib Naukluft and Dorob National Park
25 February 2022	Roads Authority
01 March 2022	Coastal Tourism Association
02 March 2022	Palmenhorst Property along the Swakop River

The following entities/IAPs were contacted to set up a Focus Group Meeting, but the request was declined with the primary reason being that the water pipeline does not really impact them directly.

i. Goanikontes Oasis - Property and business along the Swakop River

ii. Haigamgab - Property along the Swakop River

On the 11th February a special project coordination meeting was held with Namwater and the Consulting Engineers Lund who have been engaged to design the water pipeline. Present at this meeting were the following people:

Mr L Muhimba NamWater

Mr P Conradie NamWater

Mr S Shaanika NamWater

Mr H Drews NamWater

Mr T Silombela NamWater

Mr G R Brettschneider Lund Consulting Engineers

Mrs A Swarts Lund Consulting Engineers

Mr D Calitz Lund Consulting Engineers

Mr C van Heerden Lund Consulting Engineers

Mr F Kuchling Lund Consulting Engineers

Mr W Ewald Bannerman Mining Resources

Mr A Alberts Bannerman Mining Resources

Mr. Ewald informed the meeting that the Environmental Impact Assessment is being conducted by A. Speiser Environmental Consultants and that specialists in the fields of fauna, flora and archeology are involved. The existing infrastructure corridor would be used i.e. the pipeline would be positioned next to the existing pipelines with adequate space available for servicing and repair should this be required. The Environmental Management Plan for the construction and operation of this pipeline would follow similar standards as was the case with the Langer Heinrich and Husab pipeline.

To comply with the standards and requirements of NamWater, all System, Design and Operational requirements and specification are required. It was agreed that the Consultant will liaise directly with the Mechanical & Electrical, Civil and Operation Section of NamWwater to obtain the required specifications and design standards. Mr. Muhimba of NamWater will be copied in with all requests and discussions.

Other engineering related issues were also discussed at this meeting.

4.4 Summary of issues raised

Table 7 below summaries the comments received (through e-mails) and during the Focus Group and the responses.

Table 7: Issues and comments received after the newspaper advertisements.

Issues / Comments	Raised by	Responses
Can the water for the Etango Mine not be transported up to the T-off by the existing pipelines?	Arnold Spudla Uwu-Khaeb, Warden, Namib Naukluft National Park	Unfortunately, this is not possible. The two existing pipelines have been designed for the operational demand for the respective mines (i.e. Langer Heinrich Mine and Husab Mine) with no spare capacity.
The Uranium Rush SEA mentioned that one pipeline should have been constructed to supply all potential uranium mines within the NNP.	Arnold Spudla Uwu-Khaeb, Warden, Namib Naukluft National Park	That would have been the ideal scenario, however, there was no-one to finance this option at the time. Each mine had to finance their own pipeline and mine developments do not all take place at the same time (some may never take place – this depends on the uranium market; funding etc.) For example, the proposed pipeline for the Etango Mine will cost approximately N$ 300 million.
Could the pipeline be buried?	Arnold Spudla Uwu-Khaeb, Warden, Namib Naukluft National Park	This was looked at in the EIA. There are pro and cons to both options (i.e. buried and above ground) There are already two existing pipelines in the corridor which create a potential barrier for animal movements. Animal crossings are however provided at strategic positions. There would not be a real benefit in terms of animal movement to bury the third pipeline. Additionally, burying the pipeline could cause more significant impacts relating to the disturbance of the soil, vegetation, etc. as big earth moving machinery would be needed and the soil be stored adjacent to the site. In some areas the bedrock is at the surface and blasting is not an option, as this would damage the existing pipelines.
The crossings are not used by most animals.	Arnold Spudla Uwu-Khaeb, Warden, Namib Naukluft National Park	Animal movement is one of the main issues identified in the EIA. The existing crossings are close to the washes, as most animals are found in these areas. It is important to set up a monitoring system by all operating mines to investigate which crossings are used, how many animals are using them and which ones are most effective. The design of the crossing should also be reconsidered. Making them less steep and wider at the entrances to make it easier for the animals to cross.
To supply the water, does a new desalination plant need to be build and where would this be?	Riaan Salomon, Chief Warden, Dorob National Park	Not currently but this may be the case in future. The current desal plant can supply up to 20 Mm^3 per annum and only supplies about half of that. It can also be further expanded to produce

Issues / Comments	Raised by	Responses
		25Mm^3. The option to build an additional Desalination plant is also being investigated by the MAWLR and NamWater.
Where is the water coming from?	Riaan Salomon, Chief Warden, Dorob National Park	The water at the NamWater reservoir near Swakopmund is approximately ~1/3 from the Omdel aquiver and ~2/3 from the desalination plant. The same water is used to supply residents and the mines, however the mines pay the desalination price for their water and thus technically get all their water from the existing desalination plant.
Possibility of positioning the pipeline to the south of the existing 2 pipelines, i.e. between the Langer Heinrich pipeline and the C28 Road.	A. Speiser	This would be possible as long as the infrastructure is outside of the road reserve, which is 30m to both sides of the centre line of the road.
The mines use a significant amount of water. Where will this be coming from?	Ms. Tanzi (Snr), Palmhorst	The current Desal Plant is operating at about half its capacity and it can be expanded if required. NamWater is also investigating where a second Desal Plant could be built. The mines would be using desalinated water and pay the cost of desalinated water.
Would it not make sense to only have one pipeline between Bannerman & Reptile?	Mr. H. Drews; Engineer, NamWater	The two companies have already discussed this option, but as it is not certain if both companies would go ahead with their projects and in particular the timing of each project, the base case would have to consider separate pipelines for both companies. This consideration was also developed when the Husab mine was designed, but as can be seen, the development of the mines may take place years apart and one mine would not finance another mines pipeline if it is not sure whether such mine would be developed.

5 LEGAL AND POLICY REQUIREMENTS

The Republic of Namibia has five tiers of law and a number of policies relevant to environmental assessment and protection, which includes:

- The Constitution.
- Statutory law.
- Common law.
- Customary law.
- International law.

Key policies currently in force include:

- The EIA Policy (1995).
- Namibia's Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1994).
- Environmental Management Act, 7 of 2007 and regulations.

As the main source of legislation, the Constitution of the Republic of Namibia (1990) makes provision for the creation and enforcement of applicable legislation. In this context and in accordance with its constitution, Namibia has passed numerous laws intended to protect the natural environment and mitigate against adverse environmental impacts.

The management and regulation of mining activities falls within the jurisdiction of the MME (Directorate of Mines). The environmental regulations are guided and implemented by the DEA within the MEFT.

5.1 Applicable laws and policies

In the context of the proposed (bulk water supply pipeline) Project, there are several laws and policies currently applicable. They are reflected in **Table 8**.

Table 8: List of laws applicable to the EIA.

YEAR	NAME	Natural Resource Use (energy & water)	Emissions to air (fumes, dust & odours)	Emissions to land (non-hazardous & hazardous)	Emissions to water / sea	Noise	Visual	Traffic	Impact on Land use	Impact on biodiversity	Impact on Archaeology	Socio-economic	3rd Party Safety & Health	Other
1956	Water Act, 1956 (No. 54 of 1956), as amended	X										X		
1969	National Monuments Act 28 of 1969										X			
1969	Soil Conservation Act	X			X				X					
1974	Hazardous Substance Ordinance, No. 14 of 1974													X
1975	Nature Conservation Ordinance 14 of 1975	X			X					X	X			
1976	Atmospheric Pollution Prevention Ordinance 11 of 1976		X											
1990	The Constitution of the Republic of Namibia of 1990	X	X	X	X	X	X	X	X	X	X	X	X	
1990	Petroleum Products and Energy Act, No. 13 of 1990		X	X	X					X			X	X
1990	Nature Conservation General Amendment Act 1990	X			X					X	X			
1996	Nature Conservation	X			X					X	X			

YEAR	NAME	Natural Resource Use (energy & water)	Emissions to air (fumes, dust & odours)	Emissions to land (non-hazardous & hazardous)	Emissions to water / sea	Noise	Visual	Traffic	Impact on Land use	Impact on biodiversity	Impact on Archaeology	Socio-economic	3rd Party Safety & Health	Other
	Amendment Act 5;													
2001	The Forestry Act 12 of 2001	**X**							**X**	**X**				
2001	The Wildlife and Protected Areas Management Bill									**X**				
2003	Pollution Control and Waste Management Bill (3rd Draft September 2003)		**X**	**X**	**X**	**X**								
2004	National Heritage Act 27 of 2004										**X**		**X**	
2007	Labour Act, 2007 (No. 11 of 2007)											**X**		
2007	Environmental Management, Act 7 of 2007	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
2012	Regulations promulgated in terms of the Environmental Management, Act 7 of 2007	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
2017	Nature Conservation Amendment Act 3	**X**			**X**					**X**	**X**			

5.2 International treaties and protocols

The following international treaties and protocols have been ratified by the Namibian Government:

- Convention on International Trade and Endangered Species of Wild Fauna and Flora (CITES) (1973)
- Vienna Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal (1989)
- Convention on Biological Diversity (1992)
- United Nations Framework Convention on Climate Change (1992)
- Kyoto Protocol on the Framework Convention on Climate Change (1998)
- World Heritage Convention (1972)
- Convention to Combat Desertification (1994)
- Stockholm Convention on Persistent Organic Pollutants (2001)

5.3 Permits and other requirements

As stipulated in the Environmental Impact Assessment Regulations, No.30 of 2012, the Environmental Clearance Certificate (ECC) needs to be obtained from MEFT:DEA before the commencement of the Project.

Additional permits, which need to be in place and be obtained by Bannerman are:

Labour Act 11 of 2007	Regulations relating to the health and safety of employees at work are contained in GN 156/1997 (GG 1617). Must be complied with on this project.
Forestry Act No 12 of 2001 **Forest Amendment Act, No. 13 of 2005**	Section 22 of the Act requires a permit for the cutting, destruction or removal of vegetation that are classified under rare and or protected species. The Act also stipulates that trees, shrubs and bushes within 100 m from a watercourse may not be cut, destroyed or removed without a permit.
National Heritage Act No 27 of 2004	No archaeological/heritage site or cultural remains may be removed, damaged, altered or excavated. 10 sites along the proposed pipeline corridor have been identified during the archaeological specialist study. These might to be saved using the Chance Find Procedure (see **Appendix H – Archaeology Specialist Study**) as stipulated in the EMP.

5.4 Strategic Environmental Management Plan (SEMP)

In 2009, the MME, after obtaining funding from the German Federal Institute for Geo-science and Natural Resources (BGR), appointed the Southern African Institute of Environmental Assessment (SAIEA) to conduct a Strategic Environmental Assessment (SEA) for the Uranium Rush in the Erongo Region.

The SEMP is an over-arching framework and roadmap to address the cumulative impacts of existing and potential developments, within which individual projects have to be planned and implemented.

Annual SEMP reports measure the performance around twelve Environmental Quality Objectives (EQOs) that show the extent to which uranium mining is impacting the central Namib. Each EQO articulates specific goals and targets that are monitored by a set of key indicators.

The applicable EQOs can be found in **Appendix 2** of the EMP (**Appendix I**) and are incorporated into the EMP.

6 DESIRABILITY AND ALTERNATIVES

The current land use in the wider area is wildlife conservation and tourism. The investigated service corridor already contains two water pipelines, a power line, the Langer Heinrich Mine Data line and the C28 district road (see **Figure 2**). So this is by no means virgin territory.

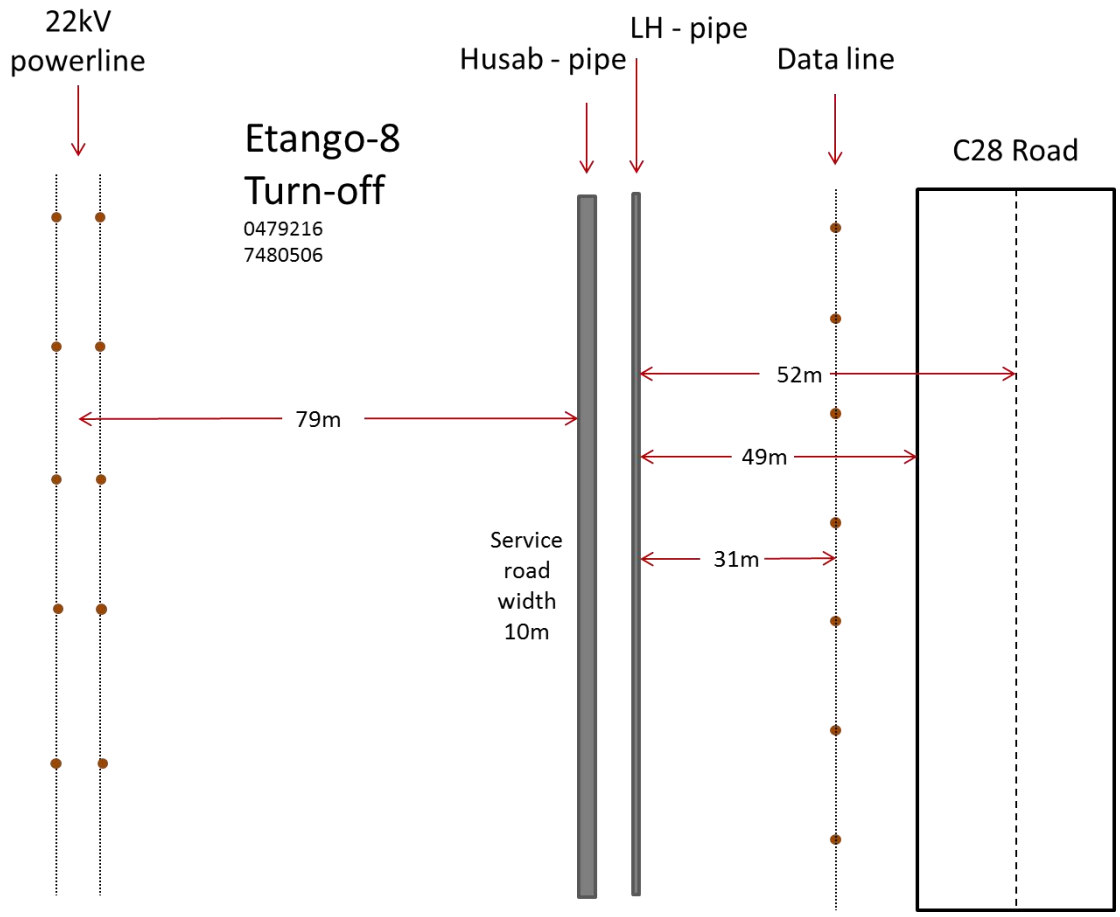


Figure 2: Existing infrastructure in the service corridor.

During the initial discussions with the proponent the possibility of routing the new pipeline(s) south of the existing pipelines and north of the data line was discussed at length (see **Figure 3**). Although it is presently considered technically not feasible because of permit and practical engineering issues e.g. adequate space for pump stations, it is by far preferable from an environmental perspective. This section of the service corridor is completely disturbed and vegetation has only recovered to some extent in washes. No lichens have re-established anywhere in this section of the service corridor.

Should it be possible, depending on the timing of the Etango pipeline project and the Tumas Project, the **best option** would be to construct one pipeline feeding both the Etango and Tumas mines.

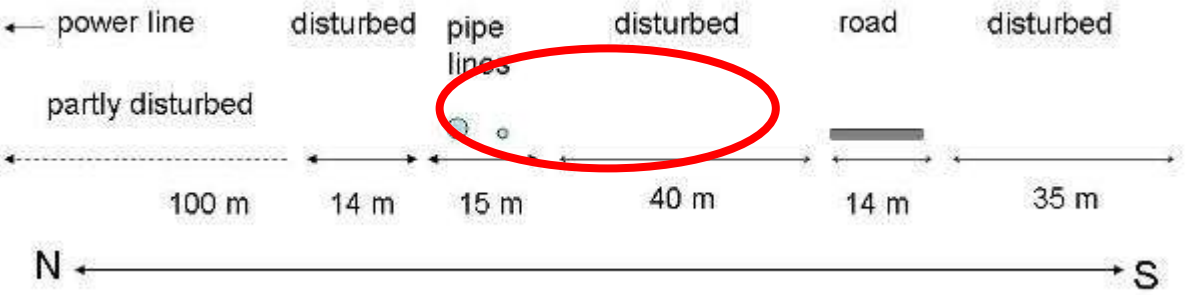


Figure 3: Recommended, but likely not feasible position of new pipeline(s) (red circle).

The no-go option, as the pipelines will be constructed in mostly disturbed areas has not been considered.

7 PROPOSED WATER PIPELINE – PROJECT DESCRIPTION

7.1 Background

Water supply for the Project is assumed to come from NamWater in the form of desalinated water for the processing and domestic requirements. The new pipeline will be constructed from the Base Pumpstation crossing the Swakop River and following the same pipeline corridor that is used for the Langer Heinrich and Swakop Uranium (i.e. Husab) Mines, branching off from the C28 Road to the Etango Project site. **Figure 4** illustrates the existing infrastructure corridor. The bulk water pipeline will largely be constructed above ground. The section being applied for now (i.e. from the base pump station near Swakopmund to the Etango Project turn off from the C28) will be ~ 30 km in length and have a diameter of 450 mm.

The existing pipelines have the following diameters (**Figure 4**):

- Langer Heinrich pipeline (south) – 250 mm
- Swakop Uranium (Husab Mine) pipeline – 600 mm

Reptile Mineral Resources & Exploration commenced with an EIA application process for their Tumas Project and associated activities, which includes (amongst others) a proposed new water pipeline to the Tumas Project area. The Environmental Teams are working closely together on both EIA projects. Bannerman and Reptile Mineral Resources & Exploration (and Deep Yellow Ltd) are in discussion to consider the likelihood of constructing a combined pipeline for the relevant section. This will greatly depend on the possibility to align the projects, as well as economic factors, e.g. sourcing of funding to start mine construction at the same time.

Figure 4: Existing infrastructure corridor, which will also accommodate the new Etango Project water pipeline.

7.2 Water supply

Desal water and the water supply (i.e. availability of water) etc. is an ongoing process of discussions / planning and negotiations between the various stakeholders, Chamber of Mines of Namibia, Namibian Uranium Association, MAWLR and NamWater.

Water will be provided by Namwater and will be desal water.

7.3 Water pipeline alignment

Discussions with engineers and Namwater staff indicate that the pipeline (or worst-case scenario 2 pipelines) will likely have to be routed north of the existing two pipelines and not south between the existing pipelines and the road (**Figure 5**).

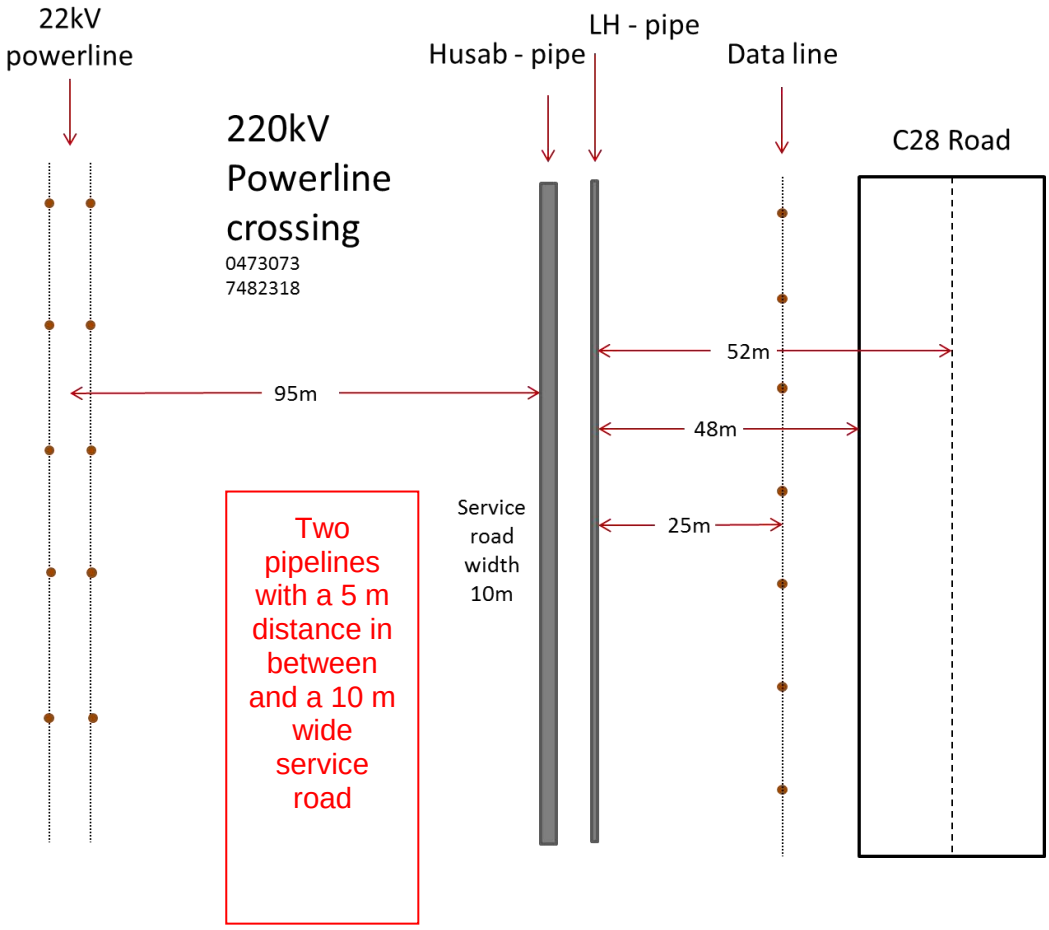


Figure 5: Worst case scenario of two water pipelines required for Etango and Tumas project positioned north of the existing pipelines.

The following needs to be considered when panning the water pipeline alignment:

- Liaise with Reptile Mineral Resources & Exploration regarding the construction of their proposed new Tumas Pipeline – i.e. 3rd pipeline along this pipeline corridor – rather than constructing a 4th pipeline;
- The pipeline should follow the existing pipeline corridor and leave sufficient space between the existing two pipelines and the proposed new pipeline for maintenance purposes;
- All "wildlife crossing points" along the existing aboveground pipeline corridor should be mimicked.

7.4 Infrastructure and construction activities

The power supply for the pump station will come from the 22kV line to the north of the existing pipelines. A cable connected onto the overhead line – going down the pole and then buried in the corridor between the 22kV line and the substation which is located next to the pump station. Exactly the same way as per the Husab pump station. The area from where the cable goes underground at the pole and up to the pump station lies within the powerlines' servitude and is already disturbed.

Construction activities will take place during the establishment and preparation of the water pipeline and associated infrastructure. The following activities are expected:

- Surveying and setting out of the final pipeline route.
- Pegging of the pipeline.
- Trench excavation for the water pipeline.
- Cleaning, grubbing, excavation and grading
- Soil excavation.
- Excess soil to be disposed of on the mine site
- Foundation excavation.
- Storage and handling of material (sand, rock, cement, chemical additives).
- Water utilization.
- Operation and movement of construction vehicles.
- Handling, storage and transportation of non-hazardous and hazardous waste.

No borrow pit will be established. Bedding material will be brought in.

Concrete will be mixed offsite; subsequently all concrete constituents (crushed stone, cement, water, and sand) will not have to be transported to site. Bases for the pipeline will be manufactured outside the NNP and transported to site. It is only the pump station that will be constructed and concrete that needs to be poured will be transported to the site by trucks either from Swakopmund or Walvis Bay.

The pipeline will be constructed using the C28 road to access the new pipeline construction area via the service road North of the Husab pipeline. Laydown areas of the pipes and other material will only utilize already disturbed areas.

7.5 Workforce / accommodation

It is estimated that the workforce **will be between 20 – 30 people**, which are accommodated outside the National Park, in Swakopmund or Walvis Bay.

7.6 Water and fuel supply and storage

Water will be transported in bowsers from the base pumpstation (see **Figure 1**) and fuel from Swakopmund.

7.7 Waste manage and rehabilitation

The following types of waste will be generated during the construction phase, in relatively small volumes:

- Domestic waste (non-hazardous).

- Industrial waste – non-hazardous (offcuts, scrap metal, empty containers, plastics and packaging and building rubble)
- Industrial waste – hazardous (i.e., hydrocarbon contaminated material / soil)

All waste generated during the construction will be contained and removed from site on a weekly basis to the Swakopmund waste dump. Hazardous waste will be disposed of at the Walvis Bay hazardous waste dump site.

After construction the entire area will be rehabilitated as set out in the EMP (see **Appendix I**).

7.7.1 Sanitation

Portable toilets and ablution facilities will be placed onsite to ensure that sewage is contained and disposed of appropriately.

7.8 Booster pump stations

Booster pump station(s) will be constructed to boost the hydraulic head and maintain the necessary flow dynamics. The booster pump station will include a brick building for housing the pumps and auxiliary equipment. A substation will be constructed adjacent to each pump house and will contain the electrical switch gear and transformer.

7.9 Power supply to the booster pumps stations

The power supply for the pump station will come from the 22kV line to the north of the existing pipelines (see section 7.4).

7.10 Construction phase timing

Construction commencement is subject to regulatory approval, i.e., approval of the EIA and issuing of an ECC by MEFT. Furthermore, the implementation of the proposed water pipeline project is subject to the agreement between NamWater and Bannerman for the supply of water from the Swakopmund reservoir.

The agreements between Bannerman and Reptile Mineral Resources & Exploration will also dictate the construction timing and the need for one of two pipelines.

At this point in time (depending upon the above-mentioned conditions), Bannerman plans to commence with operations at the mine towards mid-2025, when the 2.5 Mm^3 water per annum would be required.

Construction of the proposed pipeline would take approximately 18 months.

8 DESCRIPTIONS OF THE CURRENT ENVIRONMENT

This chapter provides an overview of the current baseline conditions of the water pipeline construction area.

The information presented in the section below was derived from the following sources:

- Visual observations during site visits to the areas during the past decades by the author.
- Literature research, including previous EIAs of the Langer Heinrich and Swakop Uranium pipeline
- Atlas of Namibia (Mendelsohn *et al,* 2002).
- Google Earth.
- Environmental specialist reports:
    - Flora specialist study by Dr. Antje Burke (**Appendix F**)
    - Vertebrate fauna specialist study by Dr. Peter Cunningham (**Appendix G**)
    - Archaeology specialist study by Dr. J. Kinahan (**Appendix H**)
- Consultation with project proponent.

8.1 Landscape and Soils

Plains, shallow and wide washes, hills and ridges characterise the study area. Quartz gravel and other rock debris cover most of the plains and hills, and sand dominates in the rivers and washes. Soils are mostly shallow lithosols and where gypsum and other salts are prominent at the surface, crusts develop. The gypsum-rich soils (gypsisols) and gravel plains support extensive lichen fields (**Figure 6**). The distribution of the lichen fields along the proposed pipeline is shown in **Figure 12**, **Section 8.6.3**). These are species-rich and support all growth forms of lichens from unattached, ground-dwelling, rock-attached to leafy forms.

Figure 6: Gypsum-rich soils form crusts in the study area and support an unique and diverse assemblage of lichens.

The service corridor crosses a largely level landscape with extensive plains which are dissected by a network of dry washes and rivers. These cross the pipeline route mostly in a north-northeast to

south-southwest draining direction. The exception is the crossing of the large Swakop River which drains east to west.

8.2 Climate

The climate in the project area is arid and falls into southern Africa's summer-rainfall region.

The Etango Project lies within the area receiving fog which forms when moist air that has been cooled over the Benguela current is blown on-shore (Pallett, 1995). Along the coast, the air remains humid throughout the year as a result of moist air feeding off the Atlantic. Even at 14h00 in winter, average humidity values drop only to 60% or 70%, while they are generally above 80% at other times (Mendelsohn *et al.*, 2002). Walvis Bay area receives on average >125 fog days per year (Molloy & Reinikainen, 2003). No data could be obtained for Swakopmund; however, experience shows that the number of fog days per year is higher. The number of fog days per year decreases eastwards (Olivier, 1995), but fog does reach the study area and probably provides a proportion of the moisture available.

Although mean annual rainfall is in the region of only about 20 mm, regular fog is observed up to 60 km inland and may exceed rainfall in this area (Hachfeld & Jürgens 2000).

Average daily temperatures vary between a minimum of 10°C in the coldest month and a maximum of 32°C in the warmest month in the area (Mendelsohn et al, 2002). Due to coastal proximity, frost is probably rare.

Winds along the coast are predominately from the south and west. High-pressure systems over the interior of southern Africa cause strong north-easterly winds, the so-called Berg winds, during the winter months. These Berg winds can blow for a number of days and are characterised by very high temperatures associated with dry and dusty conditions (Pallett, 1995).

A detailed description of the climate using the data from the Bannerman weather station was part of the Etango Project Environmental and Social Impact Assessment (ESIA) (ERM, 2011).

8.3 Air Quality

The area lies within the Namib Naukluft Park, which is regarded as ecologically sensitive. The main air pollution sources within the region, as identified during the 2019 air quality study as part of the SEMP AQMP (Liebenberg-Enslin, et al., 2019), include current mining operations, exploration activities, public roads (paved, unpaved and salt/treated), and natural exposed areas prone to wind erosion. In addition, there are a number of other sources emitting particulate matter (PM) such as harbour emissions (ships, loading and unloading activities, mobile equipment, etc.), small boilers and incinerators, commercial activities, charcoal packaging, construction activities (roads, buildings, etc.), and marine aerosols (sea salts and organic matter originating from the ocean).

The main pollutant of concern would be particulate matter (TSP; PM_{10} and $PM_{2.5}$) resulting from vehicle entrainment on the roads (paved, unpaved and treated surfaces), windblown dust, and construction activities. Gaseous pollutants such as SO_2, NOx, CO and CO_2 would result from vehicles emissions, but these are expected to be at low concentrations.

8.3.1 Vehicle entrainment from roads

The national road C28 is classified as a paved road. During the SEMP AQMP, the emissions from this road was quantified based on vehicle estimated annual average daily traffic (EAADT) figures, as provided by the Namibian Roads Authority (RA) for the year 2016. The vehicle kilometres travelled per day (VKT/day) on the paved C28 were calculated to be 3,545 VKT/day. PM emissions from C28 were low, contributing less than 0.02% to the $PM_{2.5}$ and PM_{10} emissions from the regional roads.

Dispersion modelling was conducted to identify the main contributing sources to the measured PM_{10} and $PM_{2.5}$ concentrations. Modelled results indicated that vehicle entrainment from roads (paved, unpaved and salt/treated surfaces) are the main contributing sources of PM_{10} and $PM_{2.5}$ emissions, but mostly affecting receptors close to the roads.

8.3.2 Windblown dust

In the quantification of windblown fugitive PM, use was made of the Airshed inhouse ADDAS model taking into account the particle size distribution (PSD); moisture content; particle density and friction threshold velocity. Windblown dust from natural exposed areas within the entire Erongo Region regarded to be prone to wind erosion (16,170 km²), resulted in high emissions ranging between 11 g/m²/year for $PM_{2.5}$ and 15 g/m²/year for PM_{10}. When reported as a soil (PM) loss per square metre (m²), the erosion losses seem reasonable when compared to other reported soil/PM_{10} losses due to wind erosion (Pi et al., 2018; Schepanski, 2018). The percentage hours where emission rates occurred ranged between 0.1% and 2.1%, which is in line with wind speeds exceeding 10 m/s. Windblown dust from natural exposed surfaces at the area is regarded to be a significant source of particulate matter emissions under high wind speed conditions (>10 m/s).

8.4 Surface and Groundwater

The information was taken from the Etango Project Environmental and Social Impact Assessment (ESIA) (ERM, 2011).

8.4.1 Surface Water

The major hydrological feature of the Project site is the Swakop River, which is one of the four major ephemeral river systems of the central Namib, draining westwards into the Atlantic Ocean. The significant decrease in rainfall from east to west, combined with the erratic nature of runoff, and the increase in evaporation potential (from east to west) results in highly episodic flow of all rivers in the central Namib Desert. These rivers generally contain discharge for a brief period of time, following exceptionally heavy rainfall events in the catchment (BIWAC, 2010a from Ashton, 1991).

An east-west striking watershed separates the Swakop and the Tumas Catchment areas. The area to the north of the watershed forms part of the Swakop Catchment and drains towards the Swakop River in the north. Towards the Swakop River, the terrain becomes hilly and rugged and the drainage lines join to form gorges as the land surface erodes.

To the south of the watershed, shallow drainage lines drain the terrain in a south-westerly direction towards the Swakopmund-Walvis Bay Dune Belt. These drainage lines are poorly defined and are conspicuous by the perennial plants they support.

8.4.2 Groundwater

Historically, investigations into the groundwater resources of the coastal region between Walvis Bay and Henties Bay have concentrated on the alluvial aquifers of the Kuiseb, Swakop and Omaruru Rivers. Extensive investigations on the Swakop River were conducted by the CSIR in the late 1960's. These were followed by numerous studies carried out by Rössing Uranium Limited (RUL), the CSIR, and the Department of Water Affairs (DWA) (BIWAC, 2010b from CSIR, 1997).

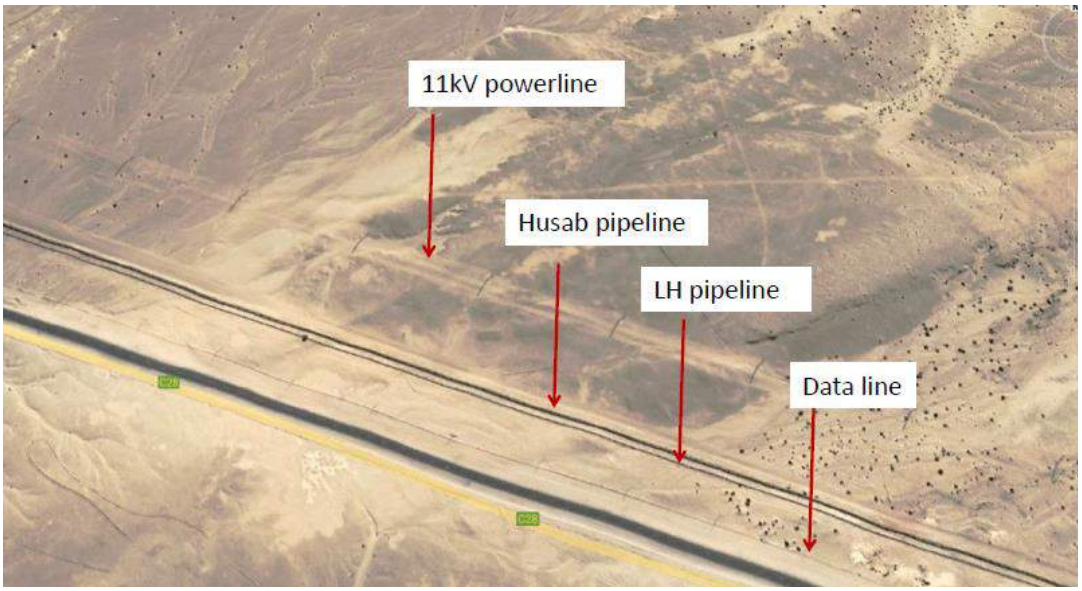
A total of 21 GHAD boreholes were drilled by Bannerman, while six WW boreholes (originally drilled by RUL), were taken over by Bannerman in 2010. Two water monitoring boreholes are close to the C28 (GHAD0011 and GHAD0012).

The water level contours obtained from these monitoring boreholes indicate a maximum groundwater elevation difference of 33 m (from north to south) across the Project area. The depth to groundwater appears to correlate with the topography of the area, generally increasing from east to west by up to approximately 37 m.

8.5 Land Use

Land use in the project area is wildlife conservation and tourism. The investigated service corridor already contains two water pipelines, a power line, a data line and the C28 district road. So this is by no means virgin territory.

However, as most of the infrastructure was established more than 10 years ago, and the newer water pipeline to the Husab Mine included rehabilitation, the service corridor has to some extent recovered and is not completely devoid of vegetation, but has not shown any recovery of lichens.



(Provided by Bannerman Mining Resources)

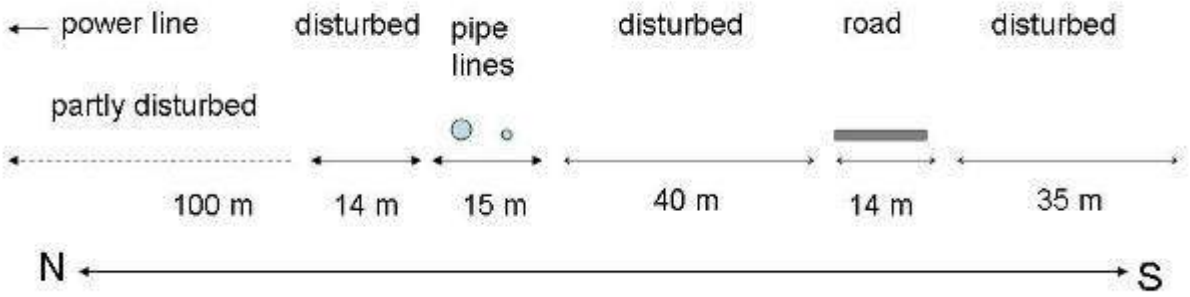


Figure 7: Aerial view and schematic cross section of existing service corridor (not entirely to scale and the measurements are approximates). The distance to the power line running north of the pipelines varies along the route, but is approximately 100 m from the disturbed area in many places.

The area beneath the existing power line (beyond the 14 m disturbed area north of the pipelines) is in many places undisturbed or has recovered. Even lichens occur in some sections (see **Figure 12**).

8.6 Flora

8.6.1 Habitats and vegetation along the pipeline route

The service corridor crosses a largely level landscape with extensive plains which are dissected by a network of dry washes and rivers.

Outside the Swakop River the vegetation is very sparse (< 1 % cover) and grows not more than 0.5 m in height. Perennial vegetation (shrubs and multi-seasonal herbs) mostly grows in washes and depressions; that is any areas that receive run-off from the rare rain events.

The pencil bush (*Arthraerua leubnitziae*), a Namib Desert endemic, is the dominant shrub along the entire pipeline route. The dollar bush (*Zygophyllum stapffii*), another Namib Desert endemic, starts to become co-dominant in the eastern section of the route.

Gypsum-rich soils and gravel plains support a great diversity of ground-dwelling lichens and extend almost along the entire route to both sides of the service corridor. Microphytic crusts (biocrusts)

composed of algae, cyanobacteria, fungi and lichens also form in patches along the entire route in undisturbed areas.

8.6.1.1 Swakop River

The Swakop River is the only area with dense vegetation, largely composed of tamarisk trees (*Tamarix usneoides* and *T. ramosissima*) and reeds (*Phragmites australis). Tamarix ramosissima* is exotic, while *T. usneoides* is the indigenous tamarisk which would normally dominate in this dry riverbed. The exotic tamarisks are problem plants in other parts of the world but have not yet been classified as invasive in Namibia (Klaassen & Kwembeya 2013). However, the Swakop River also contains many other invasive aliens such as wild tobacco (*Nicotiana glauca*), thorns apple (*Datura* species), Mexican poppy (*Argemone ochroleuca*) and castor oil bush (*Ricinus communis*).

Figure 5. Existing pipelines crossing the Swakop River.

8.6.1.2 Washes

Washes support more diverse and larger vegetation which, in addition to *Arthraerua leubnitziae* and *Zygophyllum stapffii* also include shrubs such *Galenia africana, Gomphocarpus filiformis* and the tuberous *Citrullus eccirrhosus*. These are accompanied by a variety of herbs and grasses after rain events.

One area along the route seemed to have received some run-off a few months before the field survey and additional species observed were the small succulents *Sesuvium sesuvioides* and *Zygophyllum simplex*, the Namib endemic herb *Senecio engleranus* and the grass *Stipagrostis ciliata*.

Although no *Welwitschia mirabilis* plants grow along the route section from Swakopmund to the C28 T-turn off to the Etango project site, *Welwitschia* plants start occurring just beyond the turn-off and also along the t-off section. These plants have been mapped and included in the previous assessment (ERM 2011).

Figure 8: Washes and depressions along the pipeline route support denser vegetation – here mostly dollar bushes (Zygophyllum/Tetraena stapffii).

8.6.1.3 Plains and lichen fields

Except for the first 5 km of the route from the pump station, lichen[1] fields are present on both sides of the pipeline route in an almost continuous cover, starting immediately outside the service corridor. These lichen fields are only interrupted by washes and larger, wide drainage areas. Lichens mostly grow on gravel and rocks, but cover is continuous, although changing in density across the landscape. Habitats receiving more moisture such as slight rises, ridges and hills usually show a denser cover of lichens than the more level areas. Where lichens occur, there are also often biotic crusts comprised of cynaobacteria, algae and fungi.

This part of the central Namib supports one of the most species-rich lichen fields on the planet. Many of these species are endemic to the Namib Desert and all possible life forms of lichens are present (crustose, foliose, fruticose, saxicolous, vagrants) (Wirth 2010).

[1] Taxonomically speaking, lichens are not plants, but a life form composed of two organisms, algae and fungi species. Algae are plants, but fungi have their own kingdom now. However, lichens are included here as part of the botanical assessment.

Figure 9: The dark areas on the left photo are lichen fields. Taking a closer look (right photo) they reveal an astonishing diversity of lichens.

8.6.1.4 Marble ridge

One low, N-S trending marble ridge starts south of the service corridor. Unlike many other marble ridges further inland, no additional species of particular conservation importance were observed, at least not in the vicinity of the service corridor.

8.6.2 Environmentally sensitive areas

Even in the context of working in a disturbed service corridor, there is still merit in pointing out particular habitats as environmentally sensitive. The washes and drainage areas which run across the pipeline route are such sensitive areas, as they support denser vegetation and, if these are permanently disturbed, would also alter flow patterns and thereby have secondary affects on vegetation downstream.

The lichen-covered plains, ridges and hills along the pipeline route, are environmentally sensitive areas as these are extremely slow to recover, if at all (Lalley & Viles 2006). For example no recovery has taken place in the service corridor around the existing pipelines and between the road and the pipelines. Lichens are also indicators for microphytic crusts (biocrusts). These crusts are formed by a mix of cyanobacteria, algae, fungi and mosses and are important soil stabiliser and fertilisers in deserts (e.g. Bell 1993; Eldridge & Greene 1994). Sections of lichen fields are present between the two existing pipelines and the power line. These were either not disturbed during the construction of the power line, where ground disturbance is more localised, or lichens have recovered, as the power line has been present for much longer than the pipelines.

8.6.3 Plant species

On a plant species level, only one protected species, the tree *Tamarix usneoides* was encountered along the investigated section of the route. No red-list or Cites species were recorded. The protected *Welwitschia mirabilis* grows near the C28 T-turn off from the service corridor to the mine though.

The dominant plants in this area are, however, Namib Desert endemics and therefore have a restricted distribution range. So even if they are abundant in the study area, one has to remember that the Namib Desert is the only place in the world where they occur. Many more endemic species, particularly bulbs and herbs are likely to emerge after rains.

Figure 10: The Namib endemic herb *Senecio engleranus* was in full bloom in one of the washes, probably as a result of a localised shower a few months prior to the fieldwork.

Figure 11: Lichens do not grow in the disturbed service corridor around the pipelines and between road and the pipelines. Yet they have recovered in some sections under the power line, or were not left in places undisturbed during the construction of the power line, or were not left in places undisturbed during the construction of the power line,

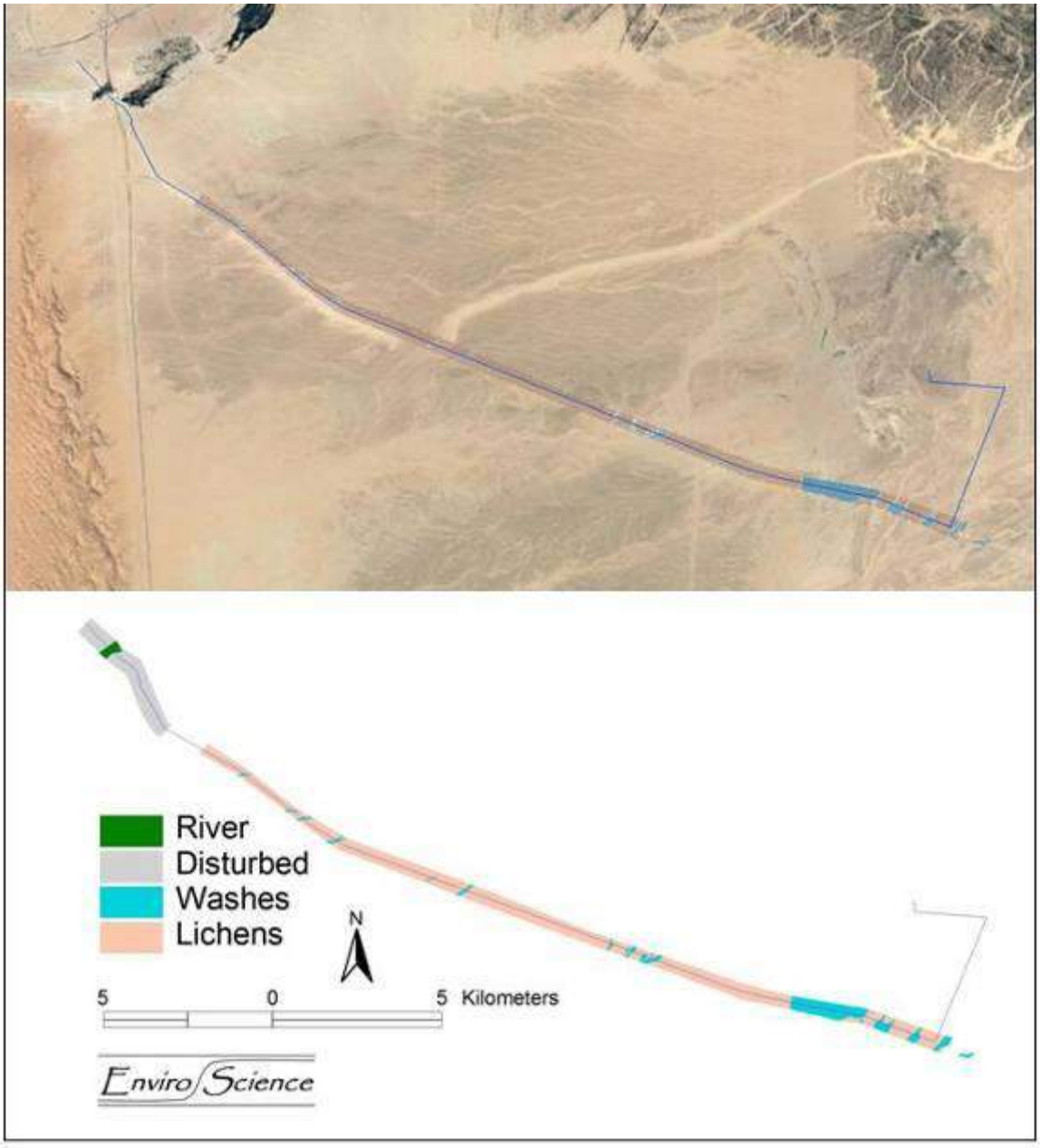


Figure 12: Extent of lichens, washes and river crossing the pipeline route – depicted with Google Earth backdrop (top) and for better clarity without backdrop (bottom).

8.7 Vertebrate Fauna

The general Swakopmund area is regarded as "low" in overall (all terrestrial species) diversity while the overall terrestrial endemism on the other hand is "moderate to high" (Mendelsohn *et al.* 2002).

8.7.4 Important Species

Reptiles

Of the 54 species of reptiles expected to occur in the general area, of which a high percentage are viewed as endemic (53.7%), only 6 species, of which 4 species are endemic (66.7%) were observed/confirmed by Cunningham (2020) while 14 and 26 species were confirmed by Cunningham (2010, 2013) in neighbouring areas, respectively.

The endemic *Pedioplanis husabensis* (Husab Sand Lizard), which is a restricted range species (100% of the taxon's range within Namibia) potentially, occurs in suitable habitat – e.g. "light

coloured" geology (marble/granite ridges) – throughout the area. Other reptile species of concern and expected to occur in the general area are the endemic *Afroedura africana africana* (African flat gecko), *Leptotyphlops occidentalis* (western thread snake) and *Lycophidion namibianum* (Namibian wolf snake).

Sedentary species – e.g. most species including all geckos – will be adversely affected by the proposed project developments, however none of the reptiles (with the exception of *P. husabensis* favouring specific geology and habitat throughout the general area) expected to occur in the general area are exclusively associated with the proposed Bannerman Water Supply Pipeline Project area.

Amphibians

Amphibians are not viewed as important throughout the Bannerman Water Supply Pipeline Project area although the ephemeral Swakop and Tumas Rivers and rock pools might occasionally serve as temporary habitat. The endemic *Poyntonophrynus hoeschi* and *Phrynomantis annectens* are viewed as the most important although they are not exclusively associated with the proposed Bannerman Water Supply Pipeline Project area.

Mammals

The most important species from the general area are the Namibian wing-gland bat (*Cistugo seabrai*) listed as endemic and rare; Littledale's whistling rat (*Protomys littledalei namibensis*) – of which the subspecies "*namibensis*" is known to occur in the ephemeral river courses in the "Swakopmund area" Griffin (2003) – listed as endemic; brown hyena (*Parahyaena brunnea*) and leopard (*Parthera pardus*) listed as near threatened and vulnerable (population trends decreasing), respectively by the IUCN (2021). However, leopard is only expected to occasionally pass through the area as the general area is not viewed as favoured habitat.

Other important species expected to occur in the general area include the African wild cat (*Felis sylvestris*), suffering genetic pollution with domestic cats throughout its range and the endemic Hartmann's mountain zebra (*Equus zebra hartmannae*), classified as "Vulnerable" by the IUCN (2021). However, the Hartmann's mountain zebra favour the better vegetated inland areas and only pass through during foraging and do not necessarily occur in the area permanently.

Sedentary species – e.g. rodents – will be adversely affected by the proposed Bannerman Water Supply Pipeline Project developments and species not being able to negotiate above ground pipeline infrastructures (e.g. Hartmann's mountain zebra); however none are exclusively associated with the proposed development areas.

Birds

The most important birds known/expected to occur in the general area are all the endemics especially Rüppels korhaan, Gray's lark and Herero chat. Gray's lark is one of the species with the most restricted range in Namibia (Simmons 1998a).

Bird species most likely to be adversely affected by the proposed Bannerman Water Supply Pipeline Project developments are the ground nesting species associated with gravel plains such as the endemic Gray's lark and Rüppell's korhaan as well as larger raptors, especially the disturbance at breeding sites (i.e. lappet-faced vulture nesting sites mainly isolated with bigger *Acacia erioloba* trees) and species not being able to negotiate above ground pipeline infrastructures (e.g. ostrich); however none are exclusively associated with the proposed development areas. .

8.7.5 Sensitive areas

The areas of most concern (see **Figures 13** and **14**), presented from most to least importance, would be:

i) Ephemeral drainage lines

The drainage lines throughout the area are mostly tributaries of the ephemeral Swakop and Tumas Rivers which drain the general area westwards towards the coast. These, often well vegetated drainage lines, are virtual lifelines for most vertebrate fauna, especially ungulates, small mammals

and birds that forage along these vegetated areas. The drainage lines often pass alongside broken rocky terrain (ecotone areas with increased diversity) which serves as habitat to a wide variety of reptiles – e.g. Namib day geckos. The entire area – Central Namib Plains – is an amalgamated area with known "red flag" zones (e.g. Hamilton Range [marble inselberg with high plant diversity] and Leeukop [inselberg with very high concentration of *Adenia pechuelli*]) by the 'uranium rush' (SAIEA 2010). According to the MEFT Namib Naukluft Management Plan, the central Namib gravel plains with inselbergs that support plains wildlife such as oryx, springbok and ostrich, are viewed as notable and important features with ephemeral river courses one of the most important habitats (MEFT 2013).

ii) Marble/Granite ridges/rocky outcrops/inselbergs (i.e. light coloured "white and grey" geology)

Ridges, outcrops and inselbergs are generally viewed as unique habitat for vertebrate fauna not necessarily associated with the surrounding plain areas. Various geckos are rock and crevasse dwelling species associated with these landforms. Caves and crevasses also serve as roosting site for bats and owls, etc. The endemic and restricted range species, *Pedioplanis husabensis* (Husab sand lizard), occurs on "light coloured" geology (marble/granite ridges) in the general area (See Cunningham 2013, Cunningham *et al.* 2012). The importance of this general area – Central Namib Plains – for "lizards which seek contrasting substrate" – i.e. *P. husabensis* – is included in the 'uranium rush' (SAIEA 2010). The MEFT (2013) views inselbergs as important from archaeological, biodiversity and aesthetic perspectives while inland rocky hills are less sensitive than inselbergs, but nonetheless important for biodiversity and refugia for plants and animals, particularly during dry periods.

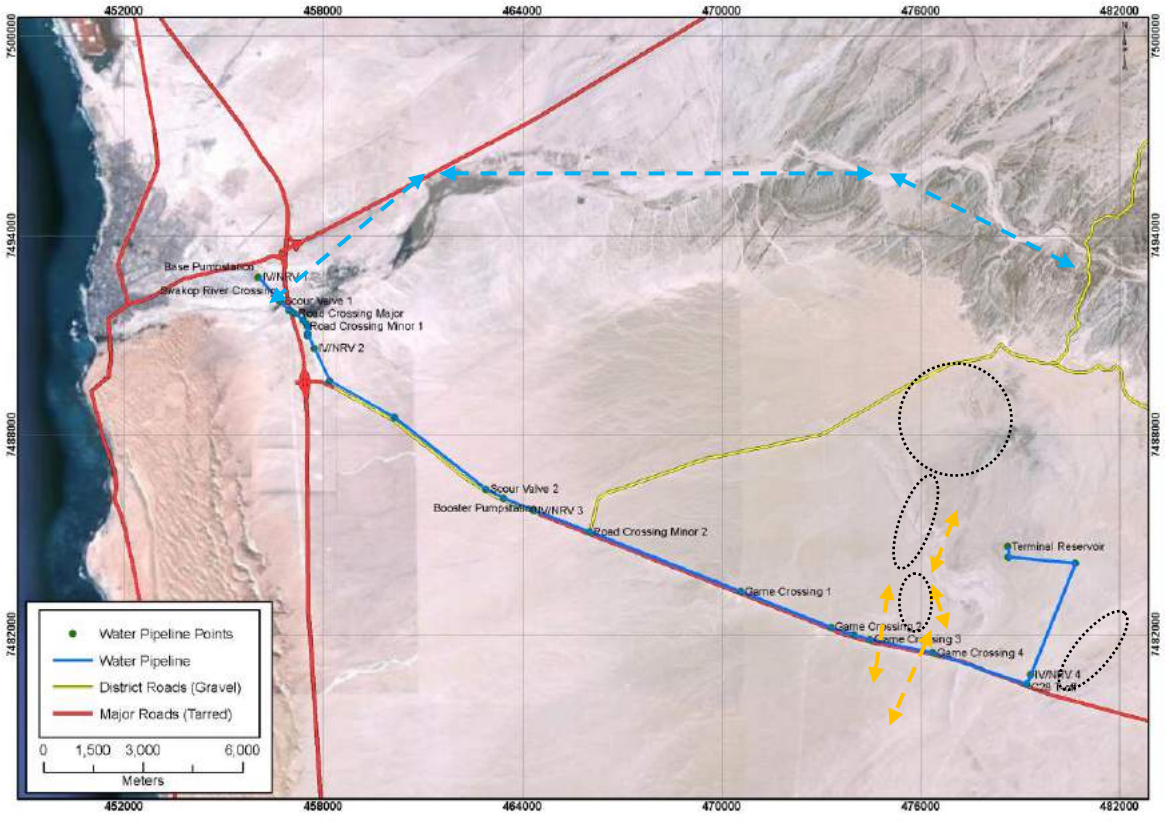


Figure 13: The most important habitat features in the general area are viewed as the Swakop River and its various tributaries (dashed blue arrows); ephemeral drainage lines (dashed orange arrows) and rocky outcrops/ridges, especially "white geology" as potential habitat for the endemic and range restricted Husab sand lizard (dotted black circles/oblongs). (Source: Google Earth).

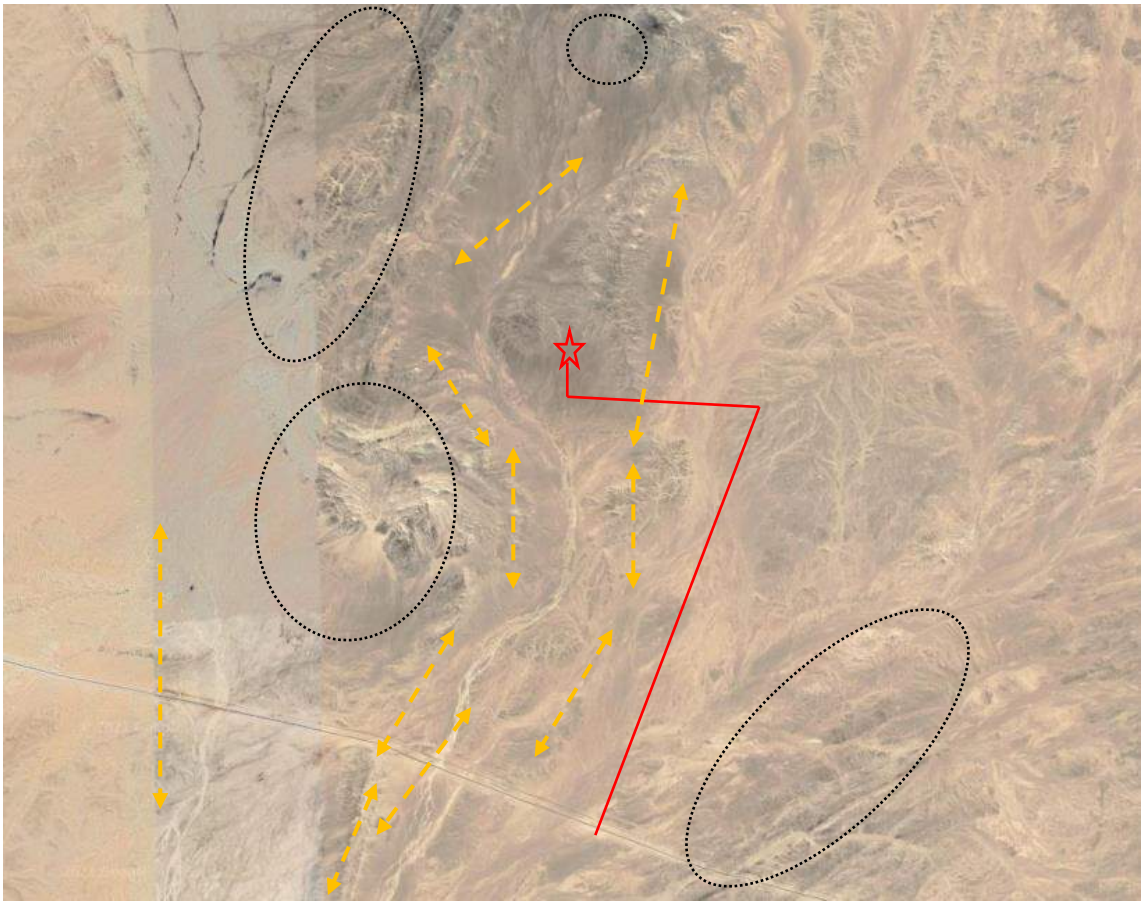


Figure 14: The most important habitat features in the immediate Terminal Reservoir and pipeline area are viewed as the various ephemeral drainage lines (dashed orange arrows) and rocky outcrops/ridges, especially "white geology" as potential habitat for the endemic and range restricted Husab sand lizard (dotted black circles/oblongs). The red star and red lines indicate the approximate location of the Terminal Reservoir and proposed T/Off pipeline route, respectively (Source: Google Earth).

8.7.3.1 Restriction of Movement of Mammals

Height

A detailed study on the effects of an aboveground pipeline infrastructure on vertebrate fauna was conducted by Cunningham et al. (2015) on a 40km section from the Swakopmund Base Station to the Langer Heinrich Mine junction. Heights, crossing points and species affected were assessed. It was determined that most springbok crossed the pipeline with heights between 40-70cm (91.1%) with the greatest number crossing at 50-60cm (44%) while gemsbok crossed with difficulty (e.g. individuals only) at 60cm. This indicates that a pipeline height of >70cm is an effective barrier to most springbok and >60cm for gemsbok while anything >80cm is a total barrier (e.g. only 0.4% of springbok crossings were above 80cm) (Cunningham et al. 2015). Although springbok have been observed crossing cattle fences of 1.5m when pressed, often with fatalities, most avoid this height (Pers. obs., Cunningham). Mountain zebra are expected to be similarly negatively affected while kudu, a typical jumping species, is not affected.

The effect of aboveground pipeline infrastructure >80cm is expected to be detrimental to most ungulates – i.e. would impede their movement, etc. As the existing above-ground pipeline(s) already act as a barrier to most ungulates (Cunningham et al. 2015) the cumulative impact of another above-ground pipeline, running adjacent these pipelines, is not expected to increase the barrier effect.

Crossing Points

Ungulate activity is associated with the availability of vegetation, especially along ephemeral drainage lines. Most pipeline crossing attempts were made in the vicinity of vegetated drainage lines (Cunningham et al. 2015).

Raised – earth covered – crossing points, 30m in width were not used by ungulates while buried sections did not impede movements at all (Cunningham et al. 2015). Swakop Uranium reported some crossing of ungulates (pers. Comm. Carlene Binneman, 2021).

Pipeline infrastructure >80cm in height would be viewed as an effective barrier to most ungulates while belowground crossing points would be best situated at drainage lines.

8.8 Archaeology

8.8.1 Archaeological Setting

The central Namib Desert contains an exceptionally well-preserved archaeological record of intermittent human occupation over the last one million years. Modern development including mining and the construction of related infrastructure has the potential to damage or destroy important archaeological evidence. Intensive mineral exploration resulting in the construction of several new uranium mines has been accompanied by a programme of detailed field survey to locate and identify archaeological sites that can be preserved or studied prior to their possible destruction. Over 320 such archaeological studies have been carried out in the last 20 years and the main results of these investigations have been published in an effort to improve public awareness and conservation of the archaeological record (Kinahan, J. 2020).

In brief, the central Namib archaeological sequence comprises the following major units:

a. Pliocene and early Pleistocene (ca. 10my to 0.128my; including OIS 6, 7, 19 &c): represented by surface scatters of stone tools and artefact debris, usually transported from original context by fluvial action, and seldom occurring in sealed stratigraphic context.

b. Mid- to upper Pleistocene (ca. 0.128my to 0.040my; OIS 3, 4 & 5a-e): represented by dense surface scatters and rare occupation evidence in sealed stratigraphic context, with occasional associated evidence of food remains.

c. Late Pleistocene to late Holocene (ca. 0.040my to recent; OIS 1 & 2): represented by increasingly dense and highly diverse evidence of settlement, subsistence practices and ritual art, as well as grave sites and other remains.

d. Historical (the last ca. 250 years): represented by remains of crude buildings, livestock enclosures, wagon routes and watering points, as well as graves, comprising small cemeteries near farm settlements or isolated burial sites.

8.8.2 Observations

The alignment of the intended pipeline from the Base Pump Station on the outskirts of Swakopmund, to the proposed Bannerman Etango mine shown in **Figure 15** is based relevant spatial data files supplied by the project proponent. **Figure 15** also shows the alignment of the intended pipeline in relation to the documented distribution of archaeological sites in the same area. A previous archaeological survey found a relatively low density of archaeological sites along the pipeline route. Additional ground survey carried out in the course of the present investigation did not locate any further archaeological sites. The ten sites previously documented are described in **Table 9**.

Table 9: Archaeological sites found adjacent to the proposed water pipeline.

Reference on map (Figure 14)	Setting	Description
QRS 139/1	gravel plains	isolated MSA flake, hornfels
QRS 139/2	gravel plains	isolated MSA flake, hornfels
QRS 139/3	gravel plains	chunk of yellow chert with cortex trimming
QRS 139/4	drainage line	isolated MSA unifacial point, hornfels
QRS 139/5	gravel plains	isolated MSA pebble tool, ?silcrete
QRS 139/8	gravel plains	isolated MSA unifacial point, hornfels
QRS 139/10	gravel plains	isolated MSA core, hornfels
QRS 139/11	gravel plains	isolated MSA unifacial point, ?silcrete
QRS 139/12	gravel plains	isolated MSA unifacial point, hornfels
QRS 139/13	gravel plains	isolated MSA levallois unifacial point, hornfels

All of the sites are late Pleistocene Middle Stone Age artefacts with a Significance ranking of 2, indicating an “isolated minor find in undisturbed primary context, with diagnostic material”, with a Vulnerability ranking of 3/4 indicating a “probable threat from inadvertent disturbance due to proximity of development” (3) or “high likelihood of partial disturbance or destruction due to close proximity of development” (4).

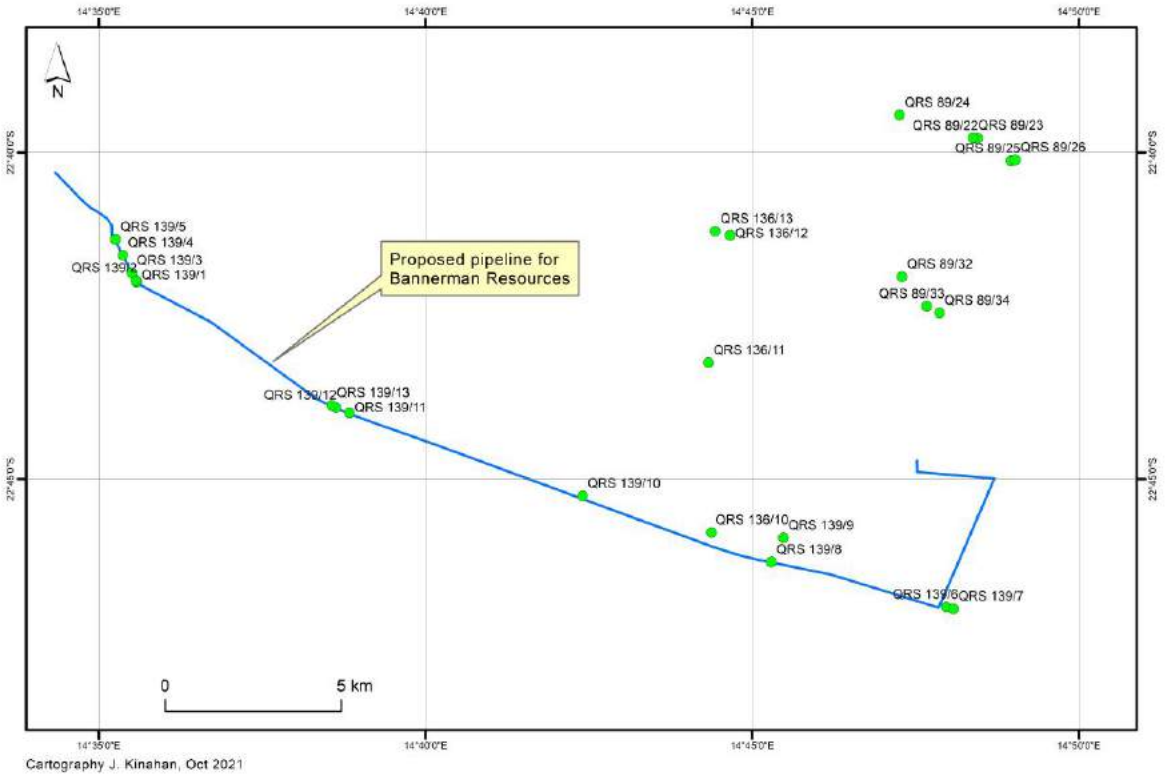


Figure 15: The archaeological setting of the proposed pipeline.

8.9 Noise

The information was taken from Soundscape Consulting (Pty) Ltd (2021) report prepared for Namisun for the Tumas project.

Along the water pipeline construction area there are no permanent noise sensitive receptors, e.g. residential areas. The transport of materials required for construction to site may impact on residential and commercial receptors within Swakopmund or Walvis Bay along the transport route. Visitors to the area may include tourists on their way to Goanikontes or to the Welwitschia site. In addition to human receptors, wildlife may also be impacted by the project.

8.10 Socio-economic Overview

The Socio-Economic information provided below was taken from 'Socio-economic baseline study as input to the Namisun EIA Scoping Report for the proposed Tumas Uranium Mine, Ashby Associations CC, 2020.

There are no established communities located within proximity to the proposed water pipeline. As such, the socio-economic environment as relevant to this EIA is largely targeted at roads users and potential socioeconomic impacts associated with increased demand on existing water utilities.

Tourism is a significant contributor to the Namibian economy, and provides over 18,000 direct jobs. The Goanikontes-Moon Landscape and Welwitschia Flats are common routes for self-drives tourists, environmental tours, bus tours and scenic flights.

The above tourism sites are within close proximity to the proposed Etango Mine. The proposed water pipeline infrastructure will have a limited footprint and is unlikely to affect these sites. However, the establishment of water pipeline infrastructure will result in visual intrusions and loss of sense of place along local tourism routes, namely the C28 and to a certain extent the C34. The proposed infrastructure will not be visual from popular viewing sites and camp facilities.

8.10.1 Demographics

8.10.1.1 Erongo Region

The Erongo Region consists of seven constituencies: Omaruru, Karibib, Daures, Arandis, Swakopmund, Walvis Bay Rural and Walvis Bay Urban (NSA, 2014). The estimated the population of the Erongo Region is approximately 175,853 people (Namibia Statistics Agency (NSA), 2017).

In 2011, people were employed in a range of industries, the most common being manufacturing (13.8% of employed population), mining and quarrying (11.7%), agriculture, forestry and fishing (11.5%), construction, administration, trade, transportation and tourism (NSA, 2014).

8.10.1.2 Walvis Bay

The estimated population of Walvis Bay in 2013 was over 79,000 and the town's annual growth rate over the last 16 years has been 4.7%. The population is distributed in suburbs that reflect the inequalities of income:

- High Income Areas 6%
- Middle Income Areas 16%
- Low Income Areas 42%
- Back Yard Shacks 36%

The Central Business District (CBD) and Naraville in the north-east, are categorised as middle-income housing areas. The high-income suburbs in the town are close to the lagoon are Meersig and the Lagoon. Other high-income suburbs of Langstrand, Dolphin Beach and Aphrodite Beach are located north of the town between the beach and the coastal road (B2) from Swakopmund and are dominated by holiday homes and characterized largely by the absentee owners.

The two areas of low-income housing are Kuisebmond and Tutuleni; the latter is a small area of ultra-high density with four households living on each 300m² plot. The residents of these shacks constitute over a third of the total population of the town. Taken together, there are over 60,000 people living in Kuisebmond, which is over 78% of Walvis Bay's people (Urban Dynamics, 2013).

Walvis Bay has experienced a significant increase in industrial activity in general and a massive growth in port related activity. This has served to fuel migration of skilled and unskilled workers from all over the country. With prospects for an increase in uranium mining activity, increased trade of fuel and other products with the SADC region through the port, and continuing rural-urban migration, it is unlikely that the town's growth will slow in the short and medium term.

8.10.1.3 Swakopmund

Swakopmund is Namibia's main coastal resort and is one of the main tourist attractions in the country, with domestic and international tourists visiting year-round. Prior to Covid-19, the tourism industry has been flourishing, with a significant number of tourist-related activities on offer. Nevertheless, mining and quarrying is the principal industry, employing the highest proportion of the population in 2011 (20%) (NSA, 2014).

The town is a magnet for people from all over Namibia and in 2011, Swakopmund recorded the region's highest population growth rate at 5.3% (NSA, 2014). The population has grown by almost 30% over census years, from 26,310 to 44,725 between 2001 and 2011, at which time it constituted 29.7% of the Erongo Region's population. Assuming the growth rate remains at 5.3%, projections indicate that the population would stand at 66,059 in 2020 and reach 89,763 by 2030.

This anticipated population growth will likely present infrastructural, housing, management and administration challenges for the town in the future (SPC Draft, 2021)[1].

Much of the growing population reside in improvised housing (informal housing/shacks), which constituted a worryingly high 41.7% of the constituency's housing in 2011 - which was the highest in the region (NSA, 2014). The majority of remaining houses were detached (32%), semi-detached (10.9%) and apartments/flats (10.7%).

These figures reflect the severe income inequality in the country as a whole and highlight the need for the exploration of more housing typologies and for a closing of the gap between the urban poor and the middle-high income groups (SPC Draft, 2021).

8.10.1.4 Incomes

In the Erongo Region, the main source of income for the vast majority of households (67,5%) comes from salaries and wages, followed by business activities (non-farming) (12.6%), pensions (7.6%) and cash remittances (3.7%) (NSA, 2019). At the per capita level, the Erongo Region ranked second behind Khomas with an annual per capita consumption of N$42,752 and N$58,807 respectively, both far above the national average of N$28,434 (NSA, 2017). In the Erongo Region, household income is predominantly spent on housing (38.6%), followed by food at (23.1%), though this is the lowest proportion nationally (NSA, 2017). Poorer households tend to spend higher proportions of their income on food and basic subsistence, indicating that households in Erongo tend to be in a less precarious position.

8.10.1.5 Employment and unemployment

In the Erongo Region, the labour force stood at 112,800 in 2018, with a labour force participation rate of 81% (86% among males and 75% among females) compared to the national average of 71%. Of those employed in Erongo, 40.9% were in informal employment – such as working in private households or in agriculture and fishing – and had none of the following social protections: a pension scheme, medical aid, or social security (NSA, 2019).

The Erongo Region also recorded the second lowest regional unemployment rate at 30%, while the unemployment rate amongst youth aged 15-34 years was 36.8%.

8.10.2 Economic Overview

Although the economy grew between 2010 and 2015 by an average of 5.3% per annum, it has not come out of recession since 2016. COVID-19 has negatively impacted commodity export markets, tourism and local consumption patterns and service industries and these are expected to result in a further 4.8% contraction of the economy in 2020. Extreme poverty is expected to rise by 2.7% in 2020, affecting more people living in urban areas, those with secondary education and those employed in construction, manufacturing, private services, trade and transport sectors (https://www.worldbank.org/en/country/namibia/overview sourced on 31/1/2021).

Tertiary industries have always been the most significant contributor to Namibia's GDP in recent years, contributing 58%, in 2019 (**Figure 16**). These industries include the public sector, retail and wholesale, transport and services sectors. Secondary industries contributed 18% to GDP and include manufacturing such as meat and other food processing, beverages, mineral processing, electricity generation and construction. The primary industries contributed 16% to GDP (NPC, 2020).

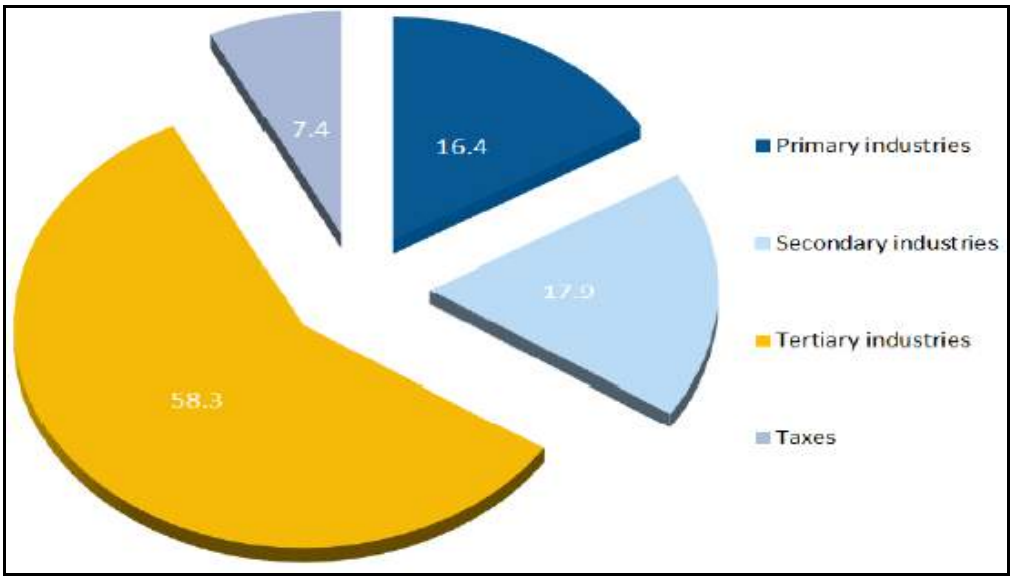


Figure 16: Industry contribution to GDP 2019. (Source: (NSA, 2020).

9 ASSESSMENT – ENVIRONMENTAL IMPACTS OF PROPOSED CONSTRUCTION OF THE BANNERMAN WATER PIPELINE

As indicated earlier the new pipeline will be constructed in an already disturbed service corridor. However, even along this corridor there are areas which are more environmentally sensitive than others, which will be assessed below without and with mitigation measures.

Table 10 shows the methodology used to conduct the qualitative assessment.

Appendix I provides the Environmental Management Plan, which sets out the commitments, mitigation and rehabilitation measures to ensure potential impacts are as far as possible avoided or minimised.

Table 10: Criteria for assessing potential impacts.

IMPACT assessment criteria	
SIGNIFICANCE determination	Significance = consequence x probability
CONSEQUENCE	Consequence is a function of: • Nature and Intensity of the potential impact • Geographical extent should the impact occur • Duration of the impact

Ranking the NATURE and INTENSITY of the potential impact	
Negative impacts	
Low (L)	The impact has no / minor effect/deterioration on natural, cultural and social functions and processes. No measurable change. Recommended standard / level will not be violated. (Limited nuisance related complaints).
Moderate (M)	Natural, cultural and social functions and processes can continue, but in a modified way. Moderate discomfort that can be measured. Recommended standard / level will occasionally be violated. Various third party complaints expected.
High (H)	Natural, cultural or social functions and processes are altered in such a way that they temporarily or permanently cease. Substantial deterioration of the impacted environment. Widespread third party complaints expected.
Very high (VH)	Substantial deterioration (death, illness or injury). Recommended standard / level will often be violated. Vigorous action expected by third parties.
Positive impacts	
Low (L) +	Slight positive effect on natural, cultural and social functions and processes Minor improvement. No measurable change.
Moderate (M) +	Natural, cultural and social functions and processes continue but in a noticeably enhanced way. Moderate improvement. Little positive reaction from third parties.
High (H) +	Natural, cultural or social functions and processes are altered in such a way that the impacted environment is considerably enhanced /improved. Widespread, noticeable positive reaction from third parties.
Very high (VH) +	Substantial improvement. Will be within or better than the recommended level. Favourable publicity from third parties.

Ranking the EXTENT	
Low (L)	Local: confined to within the project concession area and its nearby surroundings
Moderate (M)	Regional: confined to the region, e.g. coast, basin, catchment, municipal region, district, etc.
High (H)	National; extends beyond district or regional boundaries with national implications
Very high (VH)	International: Impact extends beyond the national scale or may be transboundary

Ranking the DURATION	
Low (L)	Temporary/short term. Quickly reversible. (Less than the life of the project).

Moderate (M)	Medium Term. Impact can be reversed over time. (Life of the project).
High (H)	Long Term. Impact will only cease after the life of the project.
Very high (VH)	Permanent

Ranking the PROBABILITY	
Low (L)	Unlikely
Moderate (M)	Possibly
High (H)	Most likely
Very high (VH)	Definitely

SIGNIFICANCE Description		
	Positive	**Negative**
Low (L)	Supports the implementation of the project	No influence on the decision.
Moderate (M)	Supports the implementation of the project	It should have an influence on the decision and the impact will not be avoided unless it is mitigated.
High (H)	Supports the implementation of the project	It should influence the decision to not proceed with the project or require significant modification(s) of the project design/location, etc. (where relevant).
Very high (VH)	Supports the implementation of the project	It would influence the decision to not proceed with the project.

DETERMINING THE CONSEQUENCE

DETERMINING THE CONSEQUENCE					
INTENSITY OF IMPACT = LOW					
DURATION	**VH**	**Moderate**	**Moderate**	**High**	**High**
	H	**Moderate**	**Moderate**	**Moderate**	**Moderate**
	M	**Low**	**Low**	**Low**	**Moderate**
	L	**Low**	**Low**	**Low**	**Moderate**
INTENSITY OF IMPACT = MODERATE					
DURATION	**VH**	**Moderate**	**High**	**High**	**High**
	H	**Moderate**	**Moderate**	**High**	**High**
	M	**Moderate**	**Moderate**	**Moderate**	**Moderate**
	L	**Low**	**Moderate**	**Moderate**	**Moderate**
INTENSITY OF IMPACT = HIGH					
DURATION	**VH**	**High**	**High**	**Very High**	**Very high**
	H	**High**	**High**	**High**	**Very High**
	M	**Moderate**	**Moderate**	**High**	**High**
	L	**Moderate**	**Moderate**	**High**	**High**
INTENSITY OF IMPACT = VERY HIGH					
DURATION	**VH**	**Very high**	**Very High**	**Very High**	**Very high**
	H	**High**	**High**	**Very High**	**Very high**
	M	**High**	**High**	**High**	**Very High**
	L	**Moderate**	**High**	**High**	**Very High**
		L	**M**	**H**	**VH**
		EXTENT			

DETERMINING the SIGNIFICANCE

DETERMINING THE SIGNIFICANCE					
PROBABILITY	**VH**	**Moderate**	**High**	**High**	**Very high**
	H	**Moderate**	**Moderate**	**High**	**Very high**
	M	**Low**	**Moderate**	**High**	**High**
	L	**Low**	**Low**	**Moderate**	**High**

		L	M	H	VH
		CONSEQUENCE			

9.1 Impact Assessment

The impact assessment follows the identified impacts from the various specialist. The main impacts, which need assessment and mitigation arise from flora, fauna and archaeological aspects.

Other impacts, such as air pollution, traffic, noise, etc. have been assessed in the Etango Project: Linear Infrastructure Environmental Impact Assessment, Environmental Impact Report (March /April 2011) conducted by Environmental Resources Management (see **Section 8** and **9**). Mitigation measures to these impacts are not important to the construction of the water pipeline and have not been assessed or included into the EMP. Similarly, impacts relating to waste management and socio-economic impacts are not assessed below due to the scale of the project and similar impacts assessed as part of the above-mentioned project. The relevant management and mitigation measures are included in the EMP.

9.1.1 Impacts on Flora during construction

9.1.1.1 Loss of vegetation, lichens and associated biota due to the building of the pipeline

Impact description	The excavation for the pipeline requires the clearing of some vegetation, mainly in washes. This means a loss of perennial vegetation which provides an important habitat and food source for animals. The pipeline is planned to be constructed north of the two existing pipelines and this would infringe partly on undisturbed area, particularly some sections of lichen fields.	
Intensity: Moderate Natural processes are altered, because vegetation cover will be reduced, section of lichen field will be disturbed	**Extent: Low** Local, affects only small section of washes and parts of lichen fields	**Duration: High** as vegetation will recover in washes after rains, but lichens take a very long time to recover if at all
Consequence: Moderate	**Probability: Very high** The pipeline crosses several washes and drainage areas area, and lichens start north of the two existing pipelines	**Significance: High**

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Reconsider routing pipeline south of existing pipelines Minimise ground disturbance by stockpiling excavated material in disturbed areas inside service corridor between road and existing pipelines and outside of washes and drainage areas Backfill excavated areas immediately upon laying of pipeline, should the underground option be taken. However, this will disturb a bigger area, as when the pipeline would be constructed above ground.

	Implement special rehabilitation measures where lichen fields are affected (see management guidelines)	
Intensity: Moderate Natural processes will remain altered in some areas	**Extent: Low** Local	**Duration: High** vegetation will recover in washes after rains, but lichens take a very long time to recover, if at all
Consequence: Moderate	**Probability: Moderate**, if restoration of lichen fields is successful	**Significance: Moderate**

9.1.1.2 Loss of vegetation and associated biota due to the construction work force

Impact description	Construction workers collect firewood and kindling in the Swakop River (only applicable for the first 500m)	
Intensity: Moderate; without controls people will be collecting firewood	**Extent: Low** Local, confined to project area	**Duration: Moderate** Appropriate management can reverse this impact
Consequence: Moderate	**Probability: Moderate**	**Significance: Moderate**

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	House construction staff off-site Employ environmental staff during construction Strictly enforce park regulations/rules Develop and implement Environmental Code of Conduct	
Intensity: Moderate	**Extent: Low** Local, confined to project area	**Duration: Moderate** Appropriate management can reverse this impact
Consequence: Low	**Probability: Low**	**Significance: Low**

9.1.1.3 Effect of dust on vegetation and lichens

Impact description	Dust is created during the excavation to place the pipeline underground and when support pillars are erected for the above-ground section of the pipeline	
Intensity: Moderate Natural processes continue in an altered way, as photosynthesis will be reduced in dust-covered vegetation	**Extent: Low** Very local, confined to limited areas within project area	**Duration: Low** Likely reversible after rainfall events
Consequence: Low	**Probability: Moderate**	**Significance: Low**

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Use dust suppression measures at dust sources	
Intensity: Moderate Natural processes continue in an altered way	**Extent: Low** Very local, confined to limited areas within project area	**Duration: Low** Likely reversible after rainfall events
Consequence: Low	**Probability: Moderate**	**Significance: Low**

This is likely more of a human-health aspect than an impact on biodiversity, and mitigation measures should be employed, even if this does not change the impact rating.

9.1.1.4 Introduction of invasive alien plants

Impact description	The movement of machinery and materials could result in introducing invasive alien plants such as *Datura* sp., *Nicotiana glauca* and *Prosopis* sp. This is particularly a concern if material/machinery which has been in touch with infested areas, e.g. in the Swakop River, moves onto site.	
Intensity: High Natural processes are altered, because indigenous vegetation is suppressed	**Extent: Low** Local, confined to project area	**Duration: Moderate** Appropriate management can reverse this impact
Consequence: Moderate	**Probability: Moderate**, without controls seeds will likely be brought in with vehicles and machinery	**Significance: Moderate**

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Clean underbody and tyres of machinery that was in contact with alien-infested areas Bring no material (e.g. building sand) from alien-infested sites on site Monitor sites where additional water could potentially lead to the establishment of invasive alien plants (e.g. where leaks occurred) Eradicate emerging invasive alien plants	
Intensity: High Natural processes are altered	**Extent: Low** Local, confined to project area	**Duration: Moderate** Appropriate management can reverse this impact
Consequence: Moderate	**Probability: Low**	**Significance: Low**

9.1.2 Impacts on Flora during operation

9.1.2.1 Change of habitat

Impact description	The underground pipeline may block some natural water flow, and thereby affect vegetation downstream.	
Intensity: High Natural processes are altered, because water flow is locally altered	**Extent: Low** Local	**Duration: High** Long-term to permanent
Consequence: Moderate	**Probability: High**	**Significance: Moderate**

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Bury pipeline deeper in washes and drainage areas to avoid obstructing water flow and damage by floods	
Intensity: Moderate Natural processes are altered, water flow locally altered	**Extent: Low** Local, confined to project area	**Duration: Low**
Consequence: Low	**Probability: Low**	**Significance: Low**

9.1.2.2 Introduction of invasive alien plants

Impact description	Leaks along the water pipeline can encourage the growth of invasive alien plants.	
Intensity: High Natural processes are altered, because invasive plants suppress indigenous vegetation	**Extent: Low** Local, confined to project area	**Duration: Moderate** Appropriate management can avoid or reverse this impact
Consequence: Moderate	**Probability: Moderate**	**Significance: Moderate**

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Regularly check for leaks Monitor sites for invasive alien plants along pipeline and Eradicate immediately	
Intensity: Low	**Extent: Low** Local, confined to project area	**Duration: Low** Appropriate management reverses this impact
Consequence: Low	**Probability: Low**	**Significance: Low**

9.1.3 Impacts on vertebrate fauna - Movement of vertebrate fauna (ungulates & ostrich) affected due to the building of the pipeline

9.1.3.1 During construction

Impact description	Vertebrate fauna habitat affected; open trench a pitfall trap and above ground pipeline would affect ungulate and ostrich movement.	
Intensity: Low The two existing above ground pipelines minimises the intensity of a third pipeline following the same route/corridor.	**Extent: Low** The footprint is small and negated by the existing pipelines along the same route/corridor.	**Duration: Low** The construction period is short and footprint is small.
Consequence: Moderate	**Probability: High** Habitat along drainage lines used for foraging would be affected; open trench would act as "pitfall trap"; pipeline would act as a barrier along movement corridor(s) – i.e. well vegetated drainage lines.	**Significance: Moderate**

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Sensitive habitats – i.e. 1) ephemeral drainage lines, 2) marble/granite ridges/outcrops with "light coloured" geology potentially serving as habitat to the endemic and range restricted Husab sand lizard, and • Liaise with Reptile mineral Resources & Exploration to join their proposed pipeline (i.e. 3rd pipeline along pipeline corridor) rather than constructing a 4th pipeline; • Mimic the "wildlife crossing" points along the existing pipelines – i.e. follow the same pipeline corridor; • Leave enough space between the pipelines for maintenance purposes; and • Avoid leaving an open trench overnight and/or leave access routes at each end of the trench.	
Intensity: Very low Vertebrate fauna accustomed to the existing pipeline infrastructures with a third pipeline not adding significantly to the perceived impacts, especially if	**Extent: Low** Local impacts on the movement of ungulates and ostrich.	**Duration: Low** The construction period is short and footprint is small.

mitigations followed.		
Consequence: Low	**Probability: High**	**Significance: Low**

9.1.3.2 Operational Phase

Impact description	Above ground pipeline would affect ungulate and ostrich movement.	
Intensity: Low The two existing above ground pipelines minimises the intensity of a third pipeline following the same route/corridor.	**Extent: Moderate** The existing pipelines along the route/corridor were not originally buried and consequently act as a barrier. Adding a third pipeline to the route would not exacerbate this.	**Duration: Moderate** The existing pipelines along the route/corridor were not originally buried and consequently act as a barrier. Adding a third pipeline to the route would not exacerbate this.
Consequence: Moderate	**Probability: Very High** A third pipeline will be an additional barrier along movement corridor(s) – i.e. well vegetated drainage lines.	**Significance: Very High**

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Sensitive habitats – i.e. 1) ephemeral drainage lines, 2) marble/granite ridges/outcrops with "light coloured" geology potentially serving as habitat to the endemic and range restricted Husab sand lizard Bury pipeline, where possible (depending on geology) from T/Off north-eastwards to the Terminal Reservoir area.	
Intensity: Low Vertebrate fauna accustomed to the existing pipeline infrastructures with a third pipeline not adding significantly to the perceived impacts, especially if mitigations followed.	**Extent: Moderate** Local impacts on movement of ungulates and ostrich.	**Duration: Moderate** The existing pipelines along the route/corridor were not originally buried and consequently act as a barrier. Adding a third pipeline to the route would not exacerbate this.
Consequence: Moderate to Low	**Probability: High**	**Significance: Moderate to Low**

9.1.4 Impacts on archaeological sites

Only the impact during construction has been assessed, as no impacts will occur during operation of the pipeline.

9.1.4.1 During construction

Impact description	Disturbance or destruction of ten late Pleistocene Middle Stone Age artefact occurrences and their landscape setting.	
Intensity: High Some or all of the 10 identified artefacts might be destroyed.	**Extent: Low** All late Pleistocene Middle Stone Age artefacts have Significance (archaeological rating) ranking of 2 (= "isolated minor find in undisturbed primary context, with diagnostic material"), the Vulnerability ranking of 3/4 (= "probable threat from inadvertent disturbance due to proximity of development" (3) or "high likelihood of partial disturbance or destruction due to close proximity of development" (4).)	**Duration: High** Some or all of the artefacts might be destroyed permanently.
Consequence: Very high	**Probability: High**	**Significance: High**

Assessment on burying pipeline should also be done, assessing effect of excavation activities, stockpiling excavated material next to trench, importing and stockpiling bedding material, backfilling with imported bedding material, backfilling with excavated material, additional construction equipment and personnel, additional coverage of ground by disturbing movement.

Below a summary table of the assessed impact before and after mitigation is provided.

Impact	**Probability**	**Significance (before mitigation)**	**Significance (after mitigation)**
Construction - Flora			
Loss of vegetation, lichens and associated biota due to the building of the pipeline	Very high	High	Moderate
Loss of vegetation and associated biota due to the construction work force	Moderate	Moderate	Low
Effect of dust on vegetation and lichens	Moderate	Low	Low
Introduction of invasive alien plants	Moderate	Moderate	Low
Operation - Flora			

Impact	Probability	Significance (before mitigation)	Significance (after mitigation)
Change of habitat (flora)	High	Moderate	Low
Introduction of invasive alien plants	Moderate	Moderate	Low
Construction – Vertebrate Fauna			
Movement of vertebrate fauna (ungulates & ostrich) affected due to the building of the pipeline	High	Moderate	Low
Operation – Vertebrate Fauna			
Movement of vertebrate fauna (ungulates & ostrich) affected due to the building of the pipeline	Very high	Very high	Moderate - Low
Construction - Archaeology			
Disturbance or destruction of ten late Pleistocene Middle Stone Age artefact occurrences and their landscape setting.	High	High	----

10 ENVIRONMENTAL IMPACT STATEMENT AND CONCLUSION

The impact assessment presents the potential for negative environmental and social impacts that can all be mitigated to acceptable levels. The most significant potential negative impacts (unmitigated) are:

- Loss of vegetation and lichens
- Movement of wildlife
- Physical destruction and/or disturbance archaeological artefacts

The environmental aspects associated with the proposed construction of the water pipeline have been identified and assessed as part of this EIA process. Relevant mitigation measures have been provided and are included in the EMP (**Appendix I**) that accompanies this EIA report.

ASEC believes that a thorough assessment of the proposed project has been achieved and that an environmental clearance certificate could be issued on condition that the management and mitigation measure in the EMP be adhered to.

A. Speiser Environmental Consultants cc

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Wirth V. (2010) Lichens of the Namib Desert. A guide to their identification. Klaus Hess Publishers, Windhoek.

Appendix A: Curriculum Vitae

A. Speiser Environmental Consultants cc
VAT Reg. No.: 3452708015 Reg. No.: cc 2003/0606
Alexandra Speiser
MSc MPhil
P.O. Box 40386 Windhoek Namibia Tel:+264 61 244 782 Cell: 081 124 5655 e-mail:amspeiser@yahoo.com

CURRICULUM VITAE

MARIE ALEXANDRA ANGELIKA SPEISER

A. PROFESSIONAL INFORMATION

First Names:	Marie Alexandra Angelika
Surname:	Speiser
Nationality:	German (Permanent Residence in Namibia 1999)
Countries worked:	Namibia, Mozambique, Angola, Botswana, Germany
Language:	German and English (fluent)
	Portuguese (reading, understanding: good; writing: poor)
	Afrikaans (fair)
Profession:	Environmental Scientists (MPhil), Geologist (MSc)
Contact details:	P.O. Box 40386 Windhoek – Namibia
	Tel +264 61 244782 Namibian cell 081 1245655; Portuguese mobile +351 922289857 E-mail: amspeiser@yahoo.com, aspeiser1910@gmail.com

B. EDUCATION

2000 **Master of Philosophy** in Environmental Science, University of Cape Town, South Africa.
Group Thesis Title: *Environmental Situation Analysis of the Orange and Fish River Catchments*
Individual Paper Title: *Small Scale Mining in Namibia*

1994 **Master of Science** in Geology and Paleontology, Georg-August University Göttingen/Germany.
Thesis Titles: *Fluid inclusion studies in vein quartz from the Kansanshi Mine (Zambia)* and *Geological mapping of the Kansanshi Mine and surroundings.*

C. RELEVANT COURSES

November 2004

Environmental Auditor Trainings Course, Institute of Environmental Impact Assessment (IEMA) approved, Crystal Clear Consulting & Merchants (Pty) Ltd, RSA

D. PROFESSIONAL ACTIVITIES

Professional Institutes & Membership:

- Lead Practitioner and Reviewer, Environmental Assessment Professionals of Namibia (EAPAN)
- Chamber of Mines of Namibia (member)
- Namibian Chamber of Environment (member)
- Geological Society of Namibia (member)

E. EMPLOYMENT HISTORY

2012 – to 2016 Associated Environmental Consultant to SLR Namibia

2003 - to date A. Speiser – Environmental Consultants cc, Director

Main work conducted and ongoing:

- **Environmental Consultant to LK Mining Pty Ltd**: Scoping Report including Environmental Impact Assessment & Environmental Management Plan for the offshore diamond mining activities on the proposed ML 220 of LK Mining, required for an Environmental Clearance Certificate.
- **Environmental Consultant to** Hope Namibia Mineral Exploration (Pty) Ltd (part of Bezant Resources PLC): Environmental Impact Assessment process for Hope Namibia Mineral Exploration activities on EPL 6605, located east of the Namib Naukluft National Park – overlapping the Erongo and Khomas Regions
- Work packages 6 leader of the **HiTech AlkCarb Project** funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 689909 (Feb. 2016 to Jan. 2020)
- **Environmental Consultant to Virgo Resources Limited**: Environmental Impact Assessment (Scoping report & Environmental Management Plan (EMP)) for exploration activities on EPL 5796 (Namib Naukluft Park)
- **Environmental Consultant** to Kerry McNamara Architects Inc: Combined Scoping & EIA Report & EMP for the proposed Edelweiss Development (part of Okahandja Extension 7) in Okahandja
- **Environmental Consultant** to Bannerman Resources (Namibia) (Pty) Ltd: EIA/EMP for the proposed Pilot Plant on Bannerman Resources (Namibia) (Pty) Ltd EPL 3345
- **Environmental Consultant** to RPZC (Trevali): EIA/EMP for the proposed expansion of water and power infrastructure for RPZC Mine
- **Environmental Consultant** to RPZC (Glencore): EIA/EMP for the proposed zinc concentrate Storage shed at Lüderitz harbour
- **Environmental Consultant** to Metals Namibia. EO and EMP for exploration activities
- **Environmental Consultant** for the bulk chemical store of Crest Chemical Pty Ltd at Walvis Bay harbour
- **Environmental Coordinator** for the Kassinga (Angola) North and South Iron Ore Project – Area 1 (SMP / AEMR). JV between ASEC and Environmental Resource Management
- **Environmental Coordinator** for the exploration phase at Lofdal, Namibian Rare Earth (Pty) Limited
- **Environmental Consultant** to conduct bi-annual environmental audit reports for Glencore, Bannerman Resources (Namibia) Pty Ltd, Okorusu Fluorspar Pty Ltd, Namibia Rare Earth Pty Ltd, Swakop Uranium,
- **ESIA Coordinator** (amendments to the approved ESIA & ESMP) for the proposed U-mine at Etango (Bannerman Mining Resources Namibia (Pty) Ltd)
- **External Environmental Consultant** to Rössing Uranium (Rio Tinto) – SEMP: exploration drilling in the ML area within the Namib Naukluft Park
- **Reviewer** of Swakop Uranium SEIA conducted by Metago
- **ESIA Coordinator** (scoping phase) for the proposed Cu mine at Omitiomire (Craton Mining & Exploration (Pty) Ltd)
- **Mine Closure Plan** for Okorusu Fluorspar (Okorusu Fluorspar Pty Ltd)
- **Preliminary Environmental Overview** for Omitiomire Cu-deposit (Craton Mining & Exploration (Pty) Ltd)
- **ESIA Coordinator** for the proposed U-mine at Etango (Bannerman Mining Resources Namibia (Pty) Ltd) (Scoping & final ESIA approved by Government)
- **ESIA Coordinator** for the proposed Au-mine at Otjikoto, Central Namibia (Teal Exploration & Mining Inc.)
- Environmental Consultant to Walvis Bay Bulk Terminal (Pty) Ltd (EIA to construct a bulk sulphur loading & storage facility at WB harbour
- **Environmental Consultant** providing input to set up ISO 14001 & OSHAS 18000 at Rosh Pinah Mine, Rosh Pinah Zinc Corporation (Pty) Ltd
- **EIA Coordinator** for the proposed change to bulk sulphur at Skorpion Zinc, Chemical Initiatives (Pty) Ltd
- **September 2005 – June 2006, Environmental Coordinator** for the construction phase of Langer Heinrich Uranium (Pty) Ltd

- **EIA and EMP Coordinator** for proposed exploration activities for dimension stones, relevant document to grant licence by the Ministry of Mines and Energy, Olea Investment Number One (Pty) Ltd.
- **Standard Environmental Guidelines** for exploration activities, Helio Resource Corp., Canada
- **Coordinator** to compile the **Initial EMP for construction and operation** of the Langer Heinrich Uranium Mine, Paladin Resources Ltd
- **EIA & EMP (Phase 1 & 2) Coordinator** for exploration activities in the NW Namib Naukluft Park, West Africa Gold Exploration (Namibia) Pty. Ltd
- **EMP Coordinator** for Sarusas Mine, Skeleton Coast Park, Namibia, Igneous Mining Projects (Pty) Ltd
- **EIA & EMP Coordinator** for current & proposed mariculture projects of Alexkor, Alexander Bay, RSA
- **Environmental Consultant –** updating the EA & EMS for infrastructure changes at Navachab Mine, Anglogold Namibia (Pty) Ltd.
- **Team Leader**, Environmental and social assessment for World Bank/GEF Project 'Integrated ecosystem management in Namibia through the national conservancy network'
- **Bi-annual monitoring reports** auditing environmental performance of exploration activities (RPZC, B2Gold, Swakop Uranium, Okorusu Fluorspar, Namibia Rare Earth) - **ongoing**

2000 - 2003 Environmental Scientist at eco.plan (Pty) Ltd.

During this period I conducted environmental assessments and developed environmental management plans for exploration and infrastructure projects. I further was involved in the project management, public participation processes and office administration.

1999 – 2000 University of Cape Town studying Environmental Science (MPhil degree)

1997 – 1999 Self employed, Contract Geologist Scientist

- RC drilling supervision – Apatite Project / Monapo, Mozambique, subcontracted by GeoAfrica Prospecting Services (Pty.) Ltd.
- Mapping and evaluation of possible talc deposits in Central Namibia, subcontracted by Dr. T. Smaley.
- Involvement in the preliminary fact finding phase to conduct an EIA to upgrade the Cement Factory in Otjiwarongo, Namibia.
- Several Desk Studies for Anglovaal Namibia (Pty) Ltd.
- Various investigations of diamondiferous gravels of the northern bank of the Orange River.
- Drilling Supervision in the Okavango Area for InterConsult Namibia (Pty) Ltd.
- Organization of the Public Meeting for the 'Proposed Klein Windhoek River Bridge and Upgrading of Mission Road.'

1995 to 1996 Project Assistant / Geologist at the German Technical Cooperation (GTZ)

- Participation in a six-week training course at the (GTZ) Headquarter in Eschborn/Frankfurt. Focus of the training course was on project management, rural public participation appraisal and social development workshops.
- Project Assistant to the GTZ-Adviser in the Ministry of Environment & Tourism. In cooperation with the Desert Research Foundation of Namibia (DRFN) the *Chemical Residue Analysis – Kavango Region* Project was conducted. The project assessed the environmental impacts of irrigation schemes along the Okavango River, special attention was given to the use of fertilisers and pesticides.
- Project Assistant/Geologist in the *Mineral Prospecting Promotion Project*. This project was set up in cooperation with the Geological Survey of Namibia (GSN) and the Federal Institute for Geo-science and Natural Resources (BGR). The work comprised geophysical interpretation and detailed geological/geophysical ground follow-ups.

1994 – 1995 Contract Geologist

- Supervision of construction sites and conduction of soil surveys to establish possible hydrocarbon-contamination (Germany).

F. PUBLICATIONS

Alexandra Speiser, Frances Wall, Kate Smith and Kathryn Moore (2019). Policy Brief - Social licence for exploration/mining in Europe is influenced by other georesource projects such as deep and shallow geothermal energy. Deliverable of the HiTech AlkCarb Project funded by the European Union's Horizon 2020 research and innovation programme (grant agreement No. 689909.

Boonzaier A., Kuiper S. and Speiser A. (1999). Community Benefits from the Richterveld National Park: The Golden Road to the future? in IAIAsa 1999 Conference Proceedings.

Speiser A., Hein U.F. and Porada H. (1995). The Kansanshi Copper Mine (Solwezi Area, northwestern Zambia): Geology, wall rock alteration and fluid inclusions, in Pasava J. Kirbek B. and Zak K. eds., Mineral deposits: From their origin to their environmental impacts: Third Biennial Society for Geology Applied to Ore Deposits Meetings, Rotterdam, Balkema, p. 289 – 392.

Du Plessis P., Eberle D. and Speiser A. Chapter 1: Enabling Host: Southern Namibia. in Eberle D. (eds.) (1997). Promising Patterns. A new approach to the Mineral Potential of Southern Namibia.

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Appendix B: Background Information Document

BACKGROUND INFORMATION DOCUMENT

ENVIRONMENTAL IMPACT ASSESSMENT FOR BANNERMAN MINING RESOURCES' PROPOSED NEW WATER PIPELINE FROM THE BASE PUMPSTATION NEAR SWAKOPMUND TO THE ETANGO PROJECT TURN OFF FROM THE C28 ROAD

INTRODUCTION

Bannerman Mining Resources (Namibia) (Pty) Ltd (Bannerman) has an Environmental Clearance Certificate (ECC) for the proposed mining and associated activities at the Etango Project. Bannerman is currently conducting a Definitive Feasibility Study for their Etango-8 Uranium Project. The Etango-8 Project is a smaller version of the larger Etango Project, where the processing plant throughput is initially limited to 8 million tonnes of ore per year. The possible expansion to the larger Etango Project is however maintained should market conditions allow this.

Bannerman approached A. Speiser Environmental Consultants (ASEC) to submit a proposal to conduct an Environmental Impact Assessment for the water pipeline section from the base pump station near Swakopmund to the Etango Project turn off from the C28 Road (refer to **Figure 1** for the location of this section of the pipeline). The remaining section of the pipeline from the C28 Road to the Etango Project area has already been assessed and approved as part of the Etango EIA conducted between 2007 and 2008 (see **Figure 1**). Bannerman therefore needs to apply for an ECC from the Ministry of Environment, Forestry and Tourism (MEFT) for the construction of the first section of the pipeline.

ENVIRONMENTAL APPROVAL

In terms of the Environmental Management Act, 7 of 2007, a project of this nature requires an environmental impact assessment (EIA) process to apply for Environmental Clearance from the MEFT (Department of Environmental Affairs (DEA)).

PURPOSE OF THIS DOCUMENT

This document has been prepared to inform you:

* about the proposed construction of a water pipeline
* about the EIA process to be followed
* of possible environmental impacts
* how you can have input into the EIA process.

YOUR ROLE

Public involvement is an essential part of the EIA process.

You have been identified as an interested and affected party (IAP) who may want to know about the exploration and mining activities and also have input into the EIA process.

All comments will be recorded and addressed in the EIA process.

HOW TO RESPOND

Responses to this document can be submitted by means of the comment sheet or through communication with the contact person listed below.

If you would like your comments to be addressed in the EIA report please submit them by

12th November 2021

WHO TO CONTACT

Alexandra Speiser (ASEC)
Email: amspeiser@yahoo.com

or

Werner Petrick
wpetrick@namisun.com
Fax: +264 61 233820
Telephone: 081 140596

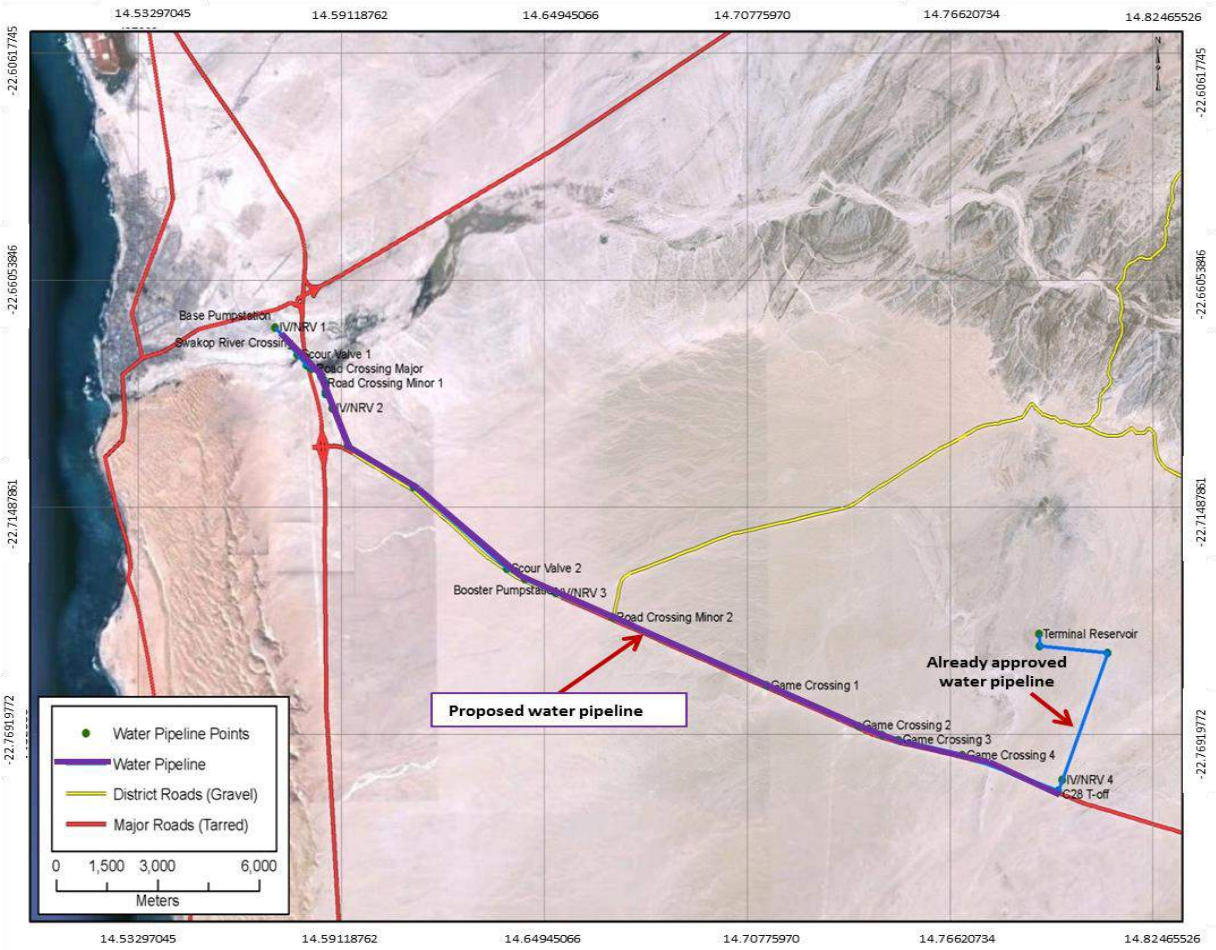


Figure 1: Location of the proposed water pipeline.

DESCRIPTION OF THE PROPOSED ACTIVITIES

The Etango Uranium Project is located on the Mineral Deposit Retention Licence 3345 (MDRL3345). In 2012 Bannerman completed a Definitive Feasibility Study for this project and also received the Environmental Clearance Certificate from the Ministry of Environment, Forestry and Tourism (MEFT). Following extensive metallurgical testing at Bannerman's Heap Leach Demonstration Plant and investigating the option of staging the project in phases, Bannerman now proposes to start the project at a smaller scale, called the Etango-8 Project and expanding to the larger project depending on the uranium market conditions. Bannerman completed a pre-feasibility study for the Etango-8 Project in August 2021 and is currently doing a Definitive Feasibility Study due to be completed in September 2022.

Water supply for the Project is assumed to come from NamWater in the form of desalinated water for the processing and domestic requirements. The same pipeline corridor that is used for the Langer Heinrich and Swakop Uranium Mines will be utilised, branching off from the C28 Road to the Etango Project site. The section from the C28 Road to the Etango Project area has been covered in the Etango Project EIA conducted between October 2007 and December 2009 by ASEC and an ECC was subsequently granted by MET (now MEFT). The bulk water pipeline will largely be constructed below ground wherever this is possible but sections will also be above ground as no blasting activities will be done for the construction of the pipeline. The section being applied for now (i.e. from the base pump station near Swakopmund to the Etango Project turn off from the C28) will be ~ 30 km in length and have a diameter of 400 mm. The remaining section to the Project area (i.e. previously assessed and approved) is ~ 5 km.

Reptile Uranium Namibia (Pty) Ltd (RUN) commenced with an EIA application process for their Tumas Project and associated activities, which includes (amongst others) a proposed new water pipeline to the Tumas Project area. The Environmental Teams are working closely together on both EIA projects.

Bannerman and RUN (and Deep Yellow Ltd) are in discussion to consider the likelihood of constructing a combined pipeline for the relevant section. However, this will greatly depend on economic factors and timing e.g. sourcing of funding to start mine construction at the same time.

PROJECT SCHEDULE

The implementation of the proposed Etango Project and associated infrastructure (including the bulk water supply pipeline) is dependent on market conditions. Furthermore, the issuing of an ECC by MEFT for the first section of the pipeline, as well as the Mining Licence by the Ministry of Mines and Energy are requirements for the implementation of the project. The construction phase of the pipeline would commence in parallel to the mine construction and would take approximately 18 months to complete (for the entire pipeline route). Depending on the above mentioned factors, construction is estimated at this stage to commence as early as the beginning of 2023.

POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

ENVIRONMENTAL ASPECT	POTENTIAL ISSUES TO BE CONSIDERED IN THE EIA PROCESS
Biodiversity	Physical destruction and general disturbance of biodiversity during construction of the pipeline.
Archaeology	Destruction and damage to archaeological sites and landscapes during construction of the pipeline.
Socio-economic	Positive economic impacts associated with income and employment during construction of the pipeline.

These aspects and others raised by interested and affected parties (IAPS) and the Environmental Team, will be considered in the EIA and mitigation measures put into the Environmental Management Plan (EMP).

THE WAY FORWARD

IAPs can register on the Project involvement database and submit any comments or questions to ASEC before 12th November 2021. These will be considered for inclusion in the draft EIA report and EMP. Meetings with I&APs are currently planned for the beginning of 2022, where the study findings associated with the proposed new water pipeline will be shared, during the review period of the EIA report.

Bannerman Mining Resources (Namibia) (Pty) Ltd
ENVIRONMENTAL IMPACT ASSESSMENT FOR BANNERMAN MINING RESOURCES' PROPOSED NEW WATER PIPELINE FROM THE BASE PUMPSTATION NEAR SWAKOPMUND TO THE ETANGO PROJECT TURN OF FROM THE C28 ROAD
REGISTRATION AND RESPONSE FORM FOR INTERESTED AND AFFECTED PARTIES

DATE		**TIME**	
PARTICULARS OF THE INTERESTED AND AFFECTED PARTY			
NAME			
POSTAL ADDRESS			
		POSTAL CODE	
STREET ADDRESS			
		POSTAL CODE	
WORK/ DAY TELEPHONE NUMBER		**WORK/ DAY FAX NUMBER**	
CELL PHONE NUMBER		**E-MAIL ADDRESS**	
PLEASE IDENTIFY YOUR INTEREST IN THE PROPOSED PROJECT			
PLEASE WRITE YOUR COMMENTS AND QUESTIONS HERE			

Appendix C: Interested & Affected Parties

NAME	ORGANISATION
ACADEMIC	
Gillian Maggs-Koelling	Gobabeb Research and Training Centre
Silke Rügheimer	National Botanical Research Institute
BUSINESS AND COMMERCE	
NAME	**ORGANISATION**
Bob Meiring	AB Financial Services
SM Fast	Alexander Forbes
Michan Bassoon	Bank Windhoek
Robin Sherbourne	Economist
Fritz Schnelle	Exotherm Energy
D Meyer	SME Compete
Adri Spangenberg	Standard Bank - Corporate Finance
Philip Coetzee	Manica Supply Chain Logistics (Philip Coetzee)
Jochi Braune	Walfish Electric
E Himner	Walfishelectric
Walter Garoeb	Oryx Mining
Santania Gerber	Woker Freight Services
Kirsten Beeker	Woker Freight Services
Lyzanne Januarie	Africa Personnel Services
Rudolf Ouseb	Erongo Red
Jacky Eyuva	EyuvaEua
Marcel Fobian	Marcels Electronics
FARMERS	
NAME	**ORGANISATION**
Mr. W. Metzger	Weizenberg (Winfried Metzger)
Mr. & Ms. Jacobs	Goanikontes Oasis (Charl & Rene Baard)
	Goanikontes East (Colin Livingstone)
	Haikamgab (Hartmut Fahrbach)
Ms. A. Tanzi and Mr. N. Green	Palmenhorst (Alexandra Tanzi)
Mr. and Ms. Kirchner	Hildenhof (Armin & Stephanie Kirchner)
GOVERNMENT - NATIONAL, REGIONAL & LOCAL	
NAME	**ORGANISATION**
	Erongo Region Governor (Hon. Neville Andre)
	Chief Regional Officer (L. Doëses)
	Chairperson Erongo Regional Council (Ciske Smith-Howard)
His Worship Nehemia Solomon	Mayor of Swakopmund
Damian Nchindo	MEFT - DEA

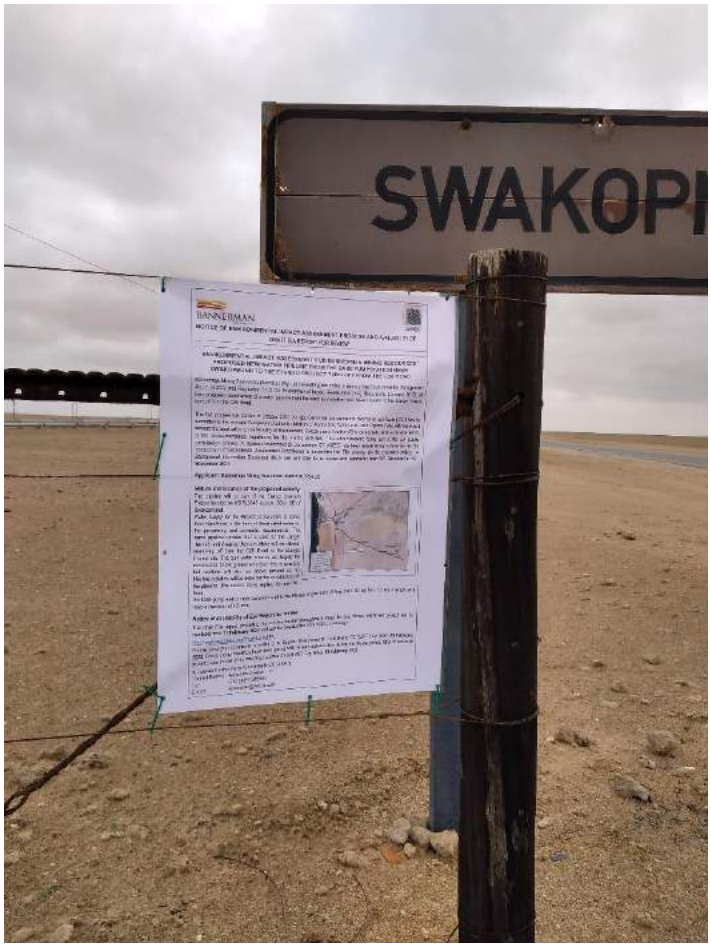
Saima Angula	MEFT - DEA
Laurica Afrikaner	Ministry of Agriculture Water and Land Reform
Bertram Swartz	Ministry of Agriculture Water and Land Reform - Hydrogeologist
Amakali A	Ministry of Agriculture Water and Land Reform- Deputy Director Water Environment
Manie Le Roux	MEFT – DPW (Chief Control Warden Central Parks)
	Warden - Namib Naukluft Park (Arnold Uwu-Khaib)
	Chief Warden: Namib Naukluft Park (David Masen)
	Warden of Ganab (Armstrong Sinvula)
Erasmus Shivolo	Ministry of Mines and Energy (Mining Commissioner)
	National Radiation Protection Authority (Mr. Axel Tibinyane)
Annalize Swart	Municipality of Swakopmund (Executive Assistant to the CEO)
Muller, Andre	Municipality of Walvis Bay
Dreyer D	Municipality of Walvis Bay
Nambahu, Ephraim	Municipality of Walvis Bay
Mr Archie Benjamin	Swakopmund Municipality - CEO
Hailaula Lovisa	Walvis Bay Municipality- Environmental Officer
INDUSTRY	
NAME	**ORGANISATION**
Abrahams, Achmet	Rossing Uranium - HSE Manager (Jacklyn Mwenze)
Schneeweiss, Rainer (RUL),	Rossing Uranium - MD (Johan Coetzee)
The Chamber of Mines of Namibia	Chamber of Mines CEO (Malango, Veston)
Yusheug Cai	Swakop Uranium (Irvinne Simaata)
	Orano Mining Namibia (Hilifa Mbako)
Sandra Müller	Orano Mining Namibia (Sandra Muller)
Francis Anderson	Langer Heinrich Uranium Mine - Environmental Manager (Francis Anderson)
Johan Roux	Langer Heinrich - MD (Johan Roux)
	Chairperson Farmers Working Group NUA (Valereis Geldenhuys)
	Reptile Mineral Resources & Exploration (Dr. Katrin Kaerner)
Magda van Wyk	ESLBE Mining
Ingrid Slaney	Toussaint – Director
J Mansfield	Keyplan
Jaco Mulder	Africa Range Group of Companies
Chris Stöck	AQUA SERVICES & ENGINEERING
Ferreira, Johnny	Grindrod
Kirstin Beeker	Woker Freight Services
Pine van Wyk	Stewardship Drilling (Pine van Wyk)
Nico Scholtz	Geologist (Nico Scholtz)
Riana Scholtz	Environmentalist (Riana Scholtz)
Karika Laas	Protea Chemicals MD (Fritz Schutz)

INDUSTRY ASSOCIATIONS	
NAME	**ORGANISATION**
Chris Brown	National Chamber of Environment (Dr Chris Brown)
Gabi Schneider	Namibian Uranium Association (Dr Gabi Schneider)
Kohrs Bertchen	Earthlife Namibia
Fennessy Julian	Namibian Nature Foundation (NNF)
Greg Stuart-Hill	World Wildlife Fund in Namibia (WWF)
Selma Shitilifa	Namibian Coast Conservation and Management Project
Nadine Kohlstaedt	Scientific Society of Swakopmund
Frank Löhnert	Namib Botanical Garden
TOURISM	
NAME	**ORGANISATION**
Danie Van Niekerk	Abenteuer Africa
Rowena Hoffmann	All Round Namibia
Harold Metzner	Charly's Desert Tours (Gerald Kolb)
James Tromp	Desert Explorers
Berry, H. C.,	Eco guide
Hans-Dieter Göthje	Kallisto Tours and Safaris
Chris Nel	Living Desert Adventures
Raini Becker	Namib Enviro Tours
Erb, George	Swakop Tour Guide
Lenssen, Joachim	Tours & Safari Association
Stacey, Jonathan	Birdlife
John Pallet	Environmental Evaluation Associates of Namibia (Pty) Ltd
Durr, Elinor	Wildlife Society of Namibia - Swakopmund
Bridgeford, Peter	Vultures Namibia
K Denker	Africa Leisure Travel
Cartwright, D	Info Tours
K Denker	Erongo Safaris (Pty) Ltd
//Naobeb, Digu	Namibian Tourist Board - CEO
Erasmus R	Suzuki Dune 7 Quad Bikes
Freer, Mark	Coastal and Tourism Association of Namibia (CTAN)
Kolb, Gerald	Coastal and Tourism Association of Namibia (CTAN)
Paetzold, Gitta	HAN - Hospitality Association of Namibian - CEO
Alte Brucke Resort	Alte Brucke Resort
Ingrid and Philip	Damarana Safaris cc
Activity Operator	Flamingo Travel CC
N Wellington	Pleasure Flights Atlantic Aviation
Activity Operator	Mola Mola Safaris CC

James Tromp	Desert Explorers
K Denker	S Kohrs Tours
James Van der Westhuizen	Business Manager for TASA
Nathaly Ahrens	TASA (Tour and Safari Association of Namibia)
du Preez, Fanie	Kuiseb Delta Adventures
Friede, Marie	Profile tours
K Denker	Namibia Explorers
Hans-Dieter Göthje	KALLISTO TOURS & SERVICES
Almuth Styles	Namib i
Chris Nel	Living Desert Adventures
Peter Von Ginkel	Coastal Tourism Association Nambia/ Baron Tours
Activity Operator	Pelican Tours
George Erb	Swartkop Tour Company
R Becker	Namib Enviro Tours
Raini Becker	Namib Enviro Tours
Awala, Marta	Namibia Tourism Board
Van Rooyen G	Walvis Bay Angling Club
Sandra Level	Charly's Desert Tours
Andre Urey	Services Charters
K Denker	Sunrise Tours & Safaris
Burkhard E	TAN, Tour Guide Association
Taschner, R	Tours Adventures Safaris CC
Tommy Collard	Tommy's Tours and Safaris
Tristan Cowley	Tours and Safari Association (chairman)
K Denker	Turnstone Tours
Hull, W	Dune 7 Sandboarding CC
Mouton, Noleen	FENATA - Federation of Namibian Tourism Associations - administrator
OTHER	
Alex Delle Donne	Impact Water Solutions Namibia (Pty) Ltd
Günter Brettschneider	Lund Consulting Engineers CC

Appendix D: Site Notice & advertisement

Site Notice



LOSING CONTROL?

ALCOHOLICS ANONYMOUS NAMIBIA

If you want to drink, that's your business.

If you want to stop, that's ours.

Windhoek: 081 325 6144
Swakopmund: 081 243 2649

E-MAIL:
alcoholicsanonymousna@gmail.com

Vacancy

Role	Pastor
Location	World Mission Society Church of God in Windhoek
Job Type	Permanent full time
Closing date	24-10-2021
Job Description	**Duties and responsibilities:** • Lead worship services, bible study meetings and voluntary activities • Provide counselling and perform administrative Duties. **Skills and experience:** • High energy and positive attitude; • A modest and compassionate personality; • - Thorough knowledge of the Bible.
Additional requirements	English with at least HIGCSE level 2
Contact details	Forward your cv to: Hafeni2012@gmail.com +264818466342

BANNERMAN

ASEC

NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

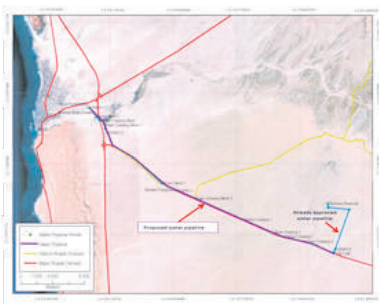
ENVIRONMENTAL IMPACT ASSESSMENT FOR BANNERMAN MINING RESOURCES' PROPOSED NEW WATER PIPELINE FROM THE BASE PUMPSTATION NEAR SWAKOPMUND TO THE ETANGO PROJECT TURN OFF FROM THE C28 ROAD

Bannerman Mining Resources (Namibia) (Pty) Ltd herewith gives notice in terms of the Environmental Management Act, 7 of 2007 and Regulation 21 of the Environmental Impact Assessment (EIA) Regulations (January 2012), of their proposed construction of a water pipeline from the base pumpstation near Swakopmund to the Etango Project turn off from the C28 Road.

Prior to implementing the proposed Project, an EIA process will be conducted. An application for environmental clearance certificate (ECC) will be submitted to the relevant Component Authority (Ministry of Agriculture, Water and Land Reform) who will review and forward the application to the Ministry of Environment, Forestry and Tourism (Environmental Commissioner) in terms of the above-mentioned regulations for the mining activities. This advertisement forms part of the EIA public participation process.

Applicant: Bannerman Mining Resources (Namibia) (Pty) Ltd

Nature and location of the proposed activity:
The pipeline will be part of the Etango Uranium Project located on MDRL3345 approx. 30km SE of Swakopmund.
Water supply for the Project is assumed to come from NamWater in the form of desalinated water for the processing and domestic requirements. The same pipeline corridor that is used for the Langer Heinrich and Swakop Uranium Mines will be utilised, branching off from the C28 Road to the Etango Project site. The bulk water pipeline will largely be constructed below ground wherever this is possible but sections will also be above ground as no blasting activities will be done for the construction of the pipeline. The section being applied for now (i.e. from the base pump station near Swakopmund to the Etango Project turn off from the C28) will be ~ 30 km in length and have a diameter of 400 mm.



Independent Environmental Assessment Practitioner:
A. Speiser Environmental Consultants CC (ASEC) has been appointed by Bannerman as the independent Environmental Assessment Practitioner to undertake the EIA process for the proposed project.

Contact Person:	Alexandra Speiser	or	Werner Petrick
Tel:			+264 (0)81 739 4591
E-mail:	amspeiser@yahoo.com		wpetrick@namisun.com

Registration to receive notifications / information and opportunity to comment:
To register as an interested and affected party for the proposed Project, please submit your name and contact details to ASEC by e-mail, or by contacting Werner Petrick. A Background Information Document (BID) is available for a review and comment period from **12th October to 12th November 2021.** Electronic copies of the BID are available on request from ASEC as per above details. Meetings with I&APs are currently planned for the beginning of 2022, where the study findings associated with the proposed new water pipeline will be shared, during the review period of the EIA report.
If you would like your comments to be addressed in the EIA Report please submit them to ASEC by **no later than 12th November 2021.**

Corporate Guarantee
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VACANCY

Corporate Guarantee has a culture of excellence and therefore strives to deliver quality, value and service in the insurance industry to the advantage of all stakeholders. To succeed continuously we acknowledge the importance of our personnel and therefore strive to be a preferred employer. Currently we have vacancies for the following:

Join our team as

Marketing Manager Windhoek

Key Performance Area's:

- Identify, develop and evaluate marketing strategy.
- Formulate, direct and coordinate marketing activities and policies to promote products and services.
- Direct the hiring, training and performance evaluations of marketing and sales staff.
- Use sales forecasting and strategic planning to ensure the sale and profitability of products.
- Coordinate and participate in promotional activities.
- Initiate market research studies and analyse.

Requirements:

- Bachelor's Degree in Finance or Marketing
- MS Office literate
- Basic knowledge of accounting principals
- Basic knowledge of Pastell & AccPac will be an advantage

Namibians that comply with the above-mentioned requirements, are invited to apply by sending their CV, certified copies of qualifications and other relevant documents to:

adminman@corporateguarantee.com
Closing date: 22 October 2021

Only candidates on the shortlist will be contacted. No documents will be returned. The Nictus group and its subsidiaries honour the letter and spirit of the Namibian affirmative action and employment equity legislation.

St Paul's College

PRINCIPAL

St Paul's is looking for suitable Namibian candidates for this position. The successful candidate will:

- be a leader of exceptional calibre
- be suitably academically qualified with a deep understanding of education in Namibia and Southern Africa
- have a proven record in educational leadership and financial management
- have sound interpersonal and communication skills
- have a deep commitment to the Catholic ethos of St Paul's College.

Applications including a covering letter, CV and three contactable references need to be emailed to:
Mrs Julie Mbaisa at principalsec@spcnam.org
by Friday, 22 October 2021.

St Paul's College,

393 Sam Nujoma Dr, Klein Windhoek

Telephone: 061-227783

Website: www.spcnam.org

ST PAUL'S COLLEGE NAMIBIA

BANNERMAN RESOURCES

ASEC

NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

ENVIRONMENTAL IMPACT ASSESSMENT FOR BANNERMAN MINING RESOURCES' PROPOSED NEW WATER PIPELINE FROM THE BASE PUMPSTATION NEAR SWAKOPMUND TO THE ETANGO PROJECT TURN OFF FROM THE C28 ROAD

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Independent Environmental Assessment Practitioner:
A. Speiser Environmental Consultants CC (ASEC) has been appointed by Bannerman as the independent Environmental Assessment Practitioner to undertake the EIA process for the proposed project.

Contact Person:	Alexandra Speiser	or	Werner Petrick
Tel:			+264 (0)81 739 4591
E-mail:	amspeiser@yahoo.com		wpetrick@namisun.com

Registration to receive notifications / information and opportunity to comment:
To register as an interested and affected party for the proposed Project, please submit your name and contact details to ASEC by e-mail, or by contacting Werner Petrick. A Background Information Document (BID) is available for a review and comment period from **12th October to 12th November 2021.** Electronic copies of the BID are available on request from ASEC as per above details. Meetings with I&APs are currently planned for the beginning of 2022, where the study findings associated with the proposed new water pipeline will be shared, during the review period of the EIA report.
If you would like your comments to be addressed in the EIA Report please submit them to ASEC by n**o later than 12th November 2021.**

Get Your Educational Booklets

TERM 3

TRANSLATIONS & DELIVERY SCHEDULE TO REGIONS
(SCHOOLS, CENTERS & REGIONAL OFFICES)

WE ARE TAKING A BREAK
FOR 1 WEEK

YOUR FOURTH BOOK FOR TERM 3 WILL BE ARRIVING SOON.
CHECK BELOW TO SEE WHEN YOUR GRADE IS COMING!

Deliveries to schools
All languages:

English, Afrikaans, Oshikwanyama, Otjiherero, Oshindonga, Rukwangali, Rumanyo, Thimbukushu, Silozi & Khoekhoegowab

TERM 3 BOOK 4 WILL BE ARRIVING SOON!

25	OCT:	**GRADE 3**	**WEEK 31 & 32**
26	OCT:	**GRADE 2**	**WEEK 31 & 32**
27	OCT:	**GRADE 1**	**WEEK 27 & 28**
28	OCT:	**PRE-PRIMARY**	**WEEK 29 & 30**

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Step 1: Find us at **www.zoshy.online or scan the QR code**
Step 2: Find your grade and select the year
Step 3: Choose your language
Step 4: Choose **the week you want to learn** out of
Step 5: Choose **lessons from what lessons** there are
Step 6: **Download booklet if you do not have it**
Step 7: Watch and follow the teacher as she explains what to do in the book
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Zoshy Telegram

Ministry of Education, Arts and Culture
NAMIBIAN COMMUNITY TRUST
unicef for every child
Capricorn Foundation

Appendix E: Advert of Focus Group Meetings, Minutes and Presentation of Focus Group Meetings

MINUTES OF FOCUS GROUP MEETING HELD ON 24 FEBRUARY 2022 AT 11H00 FOR THE EIA FOR THE PROPOSED PIPELINE FOR BANNERMAN RESOURCES

Venue: Office of the Mayor in Swakopmund
Purpose:

- Provide overview of the proposed new pipeline construction
- Understand the EIA process being followed
- Discuss potential environmental impacts
- Provide input into the EIA process

Present:

Name	Organisation	Email
L Kativa	Mayor Swakopmund Municipality	
W. Groenewald	Chair Management Committee Swakopmund Municipality	
A. Benjamin	CEO Swakopmund Municipality	
W. Ewald	Managing Director/ Project proponent / Bannerman Mining Resources (Namibia) (Pty) Ltd	
W. Petrick	Director Namisun	
A. Speiser	Director ASEC	

The Mayor welcomed the participants and everybody introduced themselves.
A hardcopy presentation was handed to all participants and W. Ewald and A. Speiser guided the participants through the presentation (**Appendix E**).

The following discussions took place:

No questions were raised specific to the proposed pipeline. However, a discussion evolved about the likelihood of starting the Etango Mine. This will all depend on the uranium price, which needs to be at US$ 65/pound and currently lies at 43US$/pound.

The meeting closed at about 11h40.

MINUTES OF FOCUS GROUP MEETING HELD ON 24 FEBRUARY 2022 AT 14H00 FOR THE EIA FOR THE PROPOSED PIPELINE FOR BANNERMAN RESOURCES

Venue: Bannerman Office in Swakopmund

Purpose:

- Provide overview of the proposed new pipeline construction
- Understand the EIA process being followed
- Discuss potential environmental impacts
- Provide input into the EIA process

Present:

Name	Organisation	Email
Arnold Spudla Uwu-Khaeb (ASU)	Warden, Namib Naukluft National Park	uarnoldspudla@yahoo.com
Riaan Salomon (RS)	Chief Warden, Dorob National Park	Riaan.Solomon@met.gov.na riaansalomon@yahoo.com
W. Ewald (WE)	Managing Director/ Project proponent / Bannerman Mining Resources (Namibia) (Pty) Ltd	wewald@bannermanresources-na.com
W. Petrick (WP)	Director Namisun	wpetrick@namisun.com
A. Speiser (AS)	Director ASEC	amspeiser@yahoo.com

W. Ewald welcomed the participants.
A hardcopy presentation was handed to all participants and W. Ewald and A. Speiser guided the participants through the presentation (**Appendix E**).
The following discussions took place.

Q/A/C	Name / Organisation	Issues
Q	ASU	You mentioned that the ownership of the pipeline after construction will be handed over to NamWater. Has this happened with the existing ones as well?
A	WE	The Langer Heinrich pipeline has been handed over, but as far as I know, the Swakop Uranium one not yet.
Q	ASU	I assume the water will be provided by NamWater. Can the water for the Etango Mine not be transported up to the T-off by the existing pipelines?
A	WE	Unfortunately, this is not possible. The two pipelines have been designed to transport the water full operational demand for the respective mines (i.e. Langer Heinrich Mine and Husab Mine).
C	ASU	The Uranium Rush SEA mentioned that one pipeline should have been constructed to supply all potential uranium mines within the NNP.
C	WE	That would have been in an ideal scenario, however, there was no-one to finance this option at the time. Each mine had to finance their own pipeline. For example, the proposed pipeline for the Etango Mine will cost approximately N$ 300 million.
Q	ASU	Could the pipeline be buried?
A	WE/AS	This was looked at in the EIA. There are pro and cons to both options (i.e. buried and above ground) There are already two existing pipelines in the corridor which create a potential barrier for animal movements. Animal crossings are however provided at strategic positions. There would not be a real benefit in terms of animal movement to bury the third pipeline Additionally, burying the pipeline could cause more significant impacts relating to the disturbance of the soil, vegetation, etc. as big

		earth moving machinery would be needed and the soil be stored adjacent to the site. In some areas the bedrock is at the surface and blasting is not an option, as this would damage the existing pipelines.
Q	ASU	The crossings are not used by most animals.
A	WP	Animal movement is one of the main issues identified in the EIA. The existing crossings are close to the washes, as most animals are found in these areas.
C	AS	It is important to set up a monitoring system by all operating mines to investigate which crossing is used, how many animals are using them and which ones. The design of the crossing should also be reconsidered. Making them less steep and wider at the entrances.
Q	WP	Which animals have you seen?
A	ASU	We have encountered an ostrich which was trapped between the pipelines.
C	ASU	It would be good if quarterly meetings with all operating mines and the Parks Authority could be initiated to discuss monitoring activities and any other issues regarding the pipelines.
C	WE	The Namibian Uranium Institute (NUI) has several Working Groups such as: (i) Radiation Safety, (ii) Services Working Group, (iii) Swakop River Farmers etc. I will discuss this with the Sustainable Development committee of the NUI which is at the moment restructuring to fall in line with the ESG drive.
C	AS	Presentation of possible location of a new pipeline: between the road and existing ones or between existing ones and the powerline. The area between the road and existing pipelines are already disturbed, but we need to find out from Roads Authority if that could be possible. Furthermore, the Engineers will have to determine if this is even an option, taking the size of the proposed booster pump station sizes into account.
C	RS	This might also not be possible, should the road be widened due to higher traffic occurrences.
Q	RS	To supply the water, does a new desal plant need to be build and where would this be?
A	WE/WP	Not currently. The current desal plant can supply up to 20 Mm^3 per annum and only supplies about half of that. It can also be further expanded to produce 25Mm^3. The option to build an additional Desalination plant is also being investigated by the MAWLR and NamWater.
C	WE	Currently the government and industry are talking of independent/private water producer. However, to transport the water, the existing NamWater infrastructure would have to be utilised.
Q	RS	Could one not build a reservoir at the Etango Mine T-off and supply water into this by the existing pipelines. The reservoir could feed the Etango Mine and the Tumas Mine.
A	WE	As mentioned earlier, the existing pipelines are sized for the two operational mines (Husab & LHU) and this idea would thus not solve the problem of installing the additional one or two pipelines. The financing of one big pipeline remains an issue as mines are really competitors to each other and the timing of projects that may or may not be built is a reality. Also, it would not be a feasible option to dismantle to two existing pipelines.
Q	RS	Where is the water coming from?
A	WP	The water at the NamWater reservoir near Swakopmund is ~1/3 from the Omdel and ~2/3 desal water. The same water is used to supply residents and the mines, however the mines pay desal price for their water and thus technically get all their water from the existing desal plant.

C	ASU	One good thing comes from the pipelines, it acts as a barrier for off-road driving. Also, at the moment there are not many animals due to the drought over the last years. They might come back after the rain.

The meeting closed at about 15h15.

MINUTES OF FOCUS GROUP MEETING HELD ON 25 FEBRUARY 2022 AT 14H00 FOR THE EIA FOR THE PROPOSED PIPELINE FOR BANNERMAN RESOURCES

Venue: Roads Authority Office in Swakopmund

Purpose:

- Provide overview of the proposed new pipeline construction
- Understand the EIA process being followed
- Discuss potential environmental impacts
- Provide input into the EIA process

Present:

Name	Organisation	Email
Lucas Geiseb	Acting Regional Manager, Roads Authority, Erongo Region	
W. Ewald	Managing Director/ Project proponent / Bannerman Mining Resources (Namibia) (Pty) Ltd	wewald@bannermanresources-na.com
W. Petrick	Director Namisun	wpetrick@namisun.com
A. Speiser	Director ASEC	amspeiser@yahoo.com

Mr. Lucas Geiseb welcomed the participants.
A hardcopy presentation was handed to the participant and W. Ewald and A. Speiser guided the participants through the presentation (**Appendix E**).

The following discussions took place:

1. Possibility of alignment of pipeline on south of the existing 2 pipelines, i.e. between the Langer Heinrich pipeline and the C28 Road.

   This would be possible as long as the infrastructure is outside of the road reserve, which is 30m to both sides of the centre line of the road.
   For telecom infrastructure, a distance of 28m is required from the centre line of the road.

2. Authorisation for constructing inside a 100 distance from the road centre line
   Any infrastructure to be constructed within 100m from the centre line of the road requires authorisation from the Roads Authority. After the proposed pipeline alignment has been designed, Bannerman need to submit the application for the construction of the pipeline and associated infrastructure to the Roads Authority.

3. Information for building the road from the C28 T-off. Although this is not part of the EIA, it was discussed while having the meeting with the Roads Authority.

   At the turn off a 400m view in both direction needs to be possible for road safety. Further Mr. Geiseb listed the documents which need to accommodate the application of a new road from the C28 to the Etango Project.

The meeting closed at 14h30.

MINUTES OF FOCUS GROUP MEETING HELD ON 1ST MARCH 2022 AT 11H15 FOR THE EIA FOR THE PROPOSED PIPELINE FOR BANNERMAN RESOURCES

Venue: Bannerman Swakopmund Office in Swakopmund

Purpose:

- Provide overview of the proposed new pipeline construction
- Understand the EIA process being followed
- Discuss potential environmental impacts
- Provide input into the EIA process

Present:

Name	Organisation	Email
Mr. Peter von Ginkel (PvG)	Chairman of the Coastal Tourism Association & Tour Operator	paintball@iway.na
W. Ewald (WE)	Managing Director/ Project proponent / Bannerman Mining Resources (Namibia) (Pty) Ltd	wewald@bannermanresources-na.com

Werner Ewald welcomed Mr. von Ginkel.
A hardcopy presentation was handed to Mr. von Ginkel and W. Ewald went through the presentation (**Appendix E**).

The following discussions took place:

1. PvG mentioned that he does not believe that a third pipeline will be more of a barrier to animal movement if the existing animal crossing positions are also maintained on the new pipeline.

   WE mentioned that the Fauna specialist had indicated this and animal crossings will be provided and furthermore an investigation into the existing animal crossings will be done to see whether these cannot be improved to ''encourage'' animals to use these crossings.

2. WE explained that most likely the pipeline will be above ground just as the two existing ones are as much of the area would need blasting to position the pipeline underground and blasting is not possible next to the pipelines. In the washes this may be possible but then it would have to be at a depth which does not impede the underground water flow.

   PvG agreed that it would be better to have the pipeline above ground as this would have less of an impact on the environment and the existing infrastructure corridor already has above ground pipelines. It would not make much sense to go underground with the third pipeline.

The meeting closed at 12h30.

MINUTES OF FOCUS GROUP MEETING HELD ON 2ND MARCH 2022 AT 12H30 FOR THE EIA FOR THE PROPOSED PIPELINE FOR BANNERMAN RESOURCES

Venue: Palmenhorst Property along the Swakop River

Purpose:

- Provide overview of the proposed new pipeline construction
- Understand the EIA process being followed
- Discuss potential environmental impacts
- Provide input into the EIA process

Present:

Name	Organisation	Email
Ms. Alex Tanzi (AT)	Owner of Palmenhort	alessandratanzi03@gmail.com
Ms. Tanzi (Snr) (TS)	Mother of owner	
Mr. Knolles Green (KG)	Partner of owner	
Mr. Werner Ewald (WE)	Managing Director/ Project proponent / Bannerman Mining Resources (Namibia) (Pty) Ltd	wewald@bannermanresources-na.com

Werner Ewald was welcomed to the Palmenhorts property by Mr. Green and Ms. A. Tanzi.
A hardcopy presentation was handed to Ms. A. Tanzi and Mr. Ewald explained where the pipeline would be situated in relation to the Palmenhort Property (**Appendix E**).

The following discussions took place:

1. WE showed on a map where the proposed pipeline would be positioned. KG indicated that this is a significant distance away from their property and why it would be necessary to discuss this? WE explained that Palmenhorst is a key stakeholder and Bannerman believes that any development of the project would need to be communicated.

2. KG said that the biggest impact he would identify is the visual impact of another pipeline. He however indicated that because a pipeline is low to the ground this impact is not as big as one has with powerlines. He suggested that the colour of the pipeline should be similar to the ground in order to minimise the visual impact.

3. TS mentioned that mines use a significant amount of water and asked where this would be coming from? WE indicated that the current Desal Plant is operating at about half its capacity and that it can be expanded if required. NamWater is also investigating where a second Desal Plant could be built. The mines would be using desalinated water and pay the cost of desalinated water.

4. WE also mentioned that the fauna, flora and archaeological impacts have been investigated by specialists and are presented in the EIA. The flora impact would be on some lichens, while the fauna impact would be similar to the existing pipelines. Animal crossings would also be constructed across the new pipeline at positions similar to the existing pipelines.

5. AT mentioned that she does not have a problem with such a pipeline as it does not really affect their property. A discussion on the uranium price required for the Etango-8 Project to be viable was held and WE explained the current market conditions and the items that would need to be in place to make the Etango-8 Project viable.

The meeting continued over lunch with no specific focus on the water pipeline but more on the cost of water. The meeting ended at 15h00.

INVITATION TO BID

NamPower

NamPower (Pty) Ltd hereby invites qualified, competent, and registered companies to submit their Bids for the under-mentioned:

Bid Number	Bid Description
G/ONB/NPWR-10/2022	Supply, Delivery, and Offloading of 11kV to 33kV NEC/NER/Auxiliary Transformers
G/ONB/NPWR-11/2022	Supply, Delivery, and Offloading of Medium Voltage Auxiliary Transformers

Cost Per Set of Documents: Free

Bid Documents Availability: Documents for this bid are available on the NamPower website www.nampower.com.na

Site Visits and Closing Date: Kindly refer to the bidding documents.

Details of Bid Submission:

Kindly submit your bid in a sealed envelope, clearly marked with the "BID NUMBER AND DESCRIPTION" as stated above, to be deposited in the Bid Box located at the entrance foyer at NamPower Centre, 15 Luther Street, Windhoek.

For Enquiries Contact:

Tel: +264 61 205 2324

Email address: bidclarifications@nampower.com.na

KINDLY NOTE: ALL INVITATIONS ARE SUBJECT TO THE PUBLIC PROCUREMENT ACT 15 OF 2015 AND ITS REGULATIONS AND GUIDELINES.

BANNERMAN RESOURCES

ASEC

NOTICE OF AVAILABILITY OF EIA REPORT FOR REVIEW

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR BANNERMAN MINING RESOURCES' PROPOSED NEW WATER PIPELINE FROM THE BASE PUMPSTATION NEAR SWAKOPMUND TO THE ETANGO PROJECT TURN OFF FROM THE C28 ROAD

The draft EIA report (including the Environmental Management Plan) for the above-mentioned project has been completed. The report can be downloaded from ASEC's webpage: http://www.asecnam.com/downloads.html
Please send your comments in writing to A. Speiser Environmental Consultants CC (ASEC) by latest 04 March 2022. Focus group meetings have been set up with various stakeholders during the review period. Should you wish to participate in one of the meetings, please contact ASEC by latest 18 February 2022.

A. Speiser Environmental Consultants CC (ASEC):
Contact Person: Alexandra Speiser
Tel: +264 (0)811245655
E-mail: amspeiser@yahoo.com

PUPKEWITZ
CUSTOMER SATISFACTION
SERVICE EXCELLENCE

Call for Expression of Interest

The Pupkewitz Group ("The Group") is a leading retailing and distribution group that creates shared value by fusing sustained commercial excellence with responsible business practices and the work of the Pupkewitz Foundation. With six operating companies and 60 branches nationwide, we bring reliable products and services to millions of Namibians.

From time to time The Group requires legal advice or assistance on a variety of matters.

In line with The Group's governance processes, the Board of Directors is seeking to establish a panel of approved law firms and/or legal practitioners to render such services to The Group.

Interested law firms and legal practitioners are invited to send an Expression of Interest ("EOI") to be included in the panel of approved service providers.

The EOI has no fixed format, but at a minimum should include:

- Background information on the practice;
- Length of existence;
- Organisational structure;
- Listing of key partners and managers;
- Services offered;
- Areas of specialisation;
- A list of references;
- Information on access to international partners, networks and resources;
- An indication of professional fee structures; and
- Potential conflicts of interest identified with The Group's existing business.

EOIs may be submitted to **Groupfd@pupkewitz.com** or by hand at Pupkewitz Holdings Offices, 63-67 Julius K Nyerere Street, Windhoek.

Closing date: 28 February 2022.

REPUBLIC OF NAMIBIA

MINISTRY OF AGRICULTURE, WATER AND LAND REFORM

SLAUGHTER & PRODUCTION CATTLE AUCTION OF ALEX MURANDA LDC

VENUE ALEX MURANDA LDC:

From Grootfontein, follow the B8 road for±182 km towards Rundu; Turn left into D3446 gravel road and drive for 7km to Alex Muranda homestead (follow road sign from tarred B8 road)

TUESDAY, 15 FEBRUARY 2022
10H00

(REGISTRATION AND VIEWING FROM 08H00)

EFT AND CASH PAYMENTS ONLY

STRICT ADHERENCE TO THE REGULATIONS DUE TO COVID-19 PANDEMIC IS VERY CRITICAL

4 COMMERCIAL NGUNI COWS
8 COMMERCIAL NGUNI HEIFERS
48 SLAUGHTER NGUNI OXEN

Enquiries:
Alex Muranda LDC Manager: Email: **alexmurandaldc@iway.na**
Mr. D. Amupolo: Email: **dkamupolo@gmail.com**
Cell: 0813112369

ENVIRONMENTAL IMPACT ASSESSMENT FOR BANNERMAN MINING RESOURCES' PROPOSED NEW WATER PIPELINE FROM THE BASE PUMPSTATION NEAR SWAKOPMUND TO THE ETANGO PROJECT TURN OFF FROM THE C28 ROAD

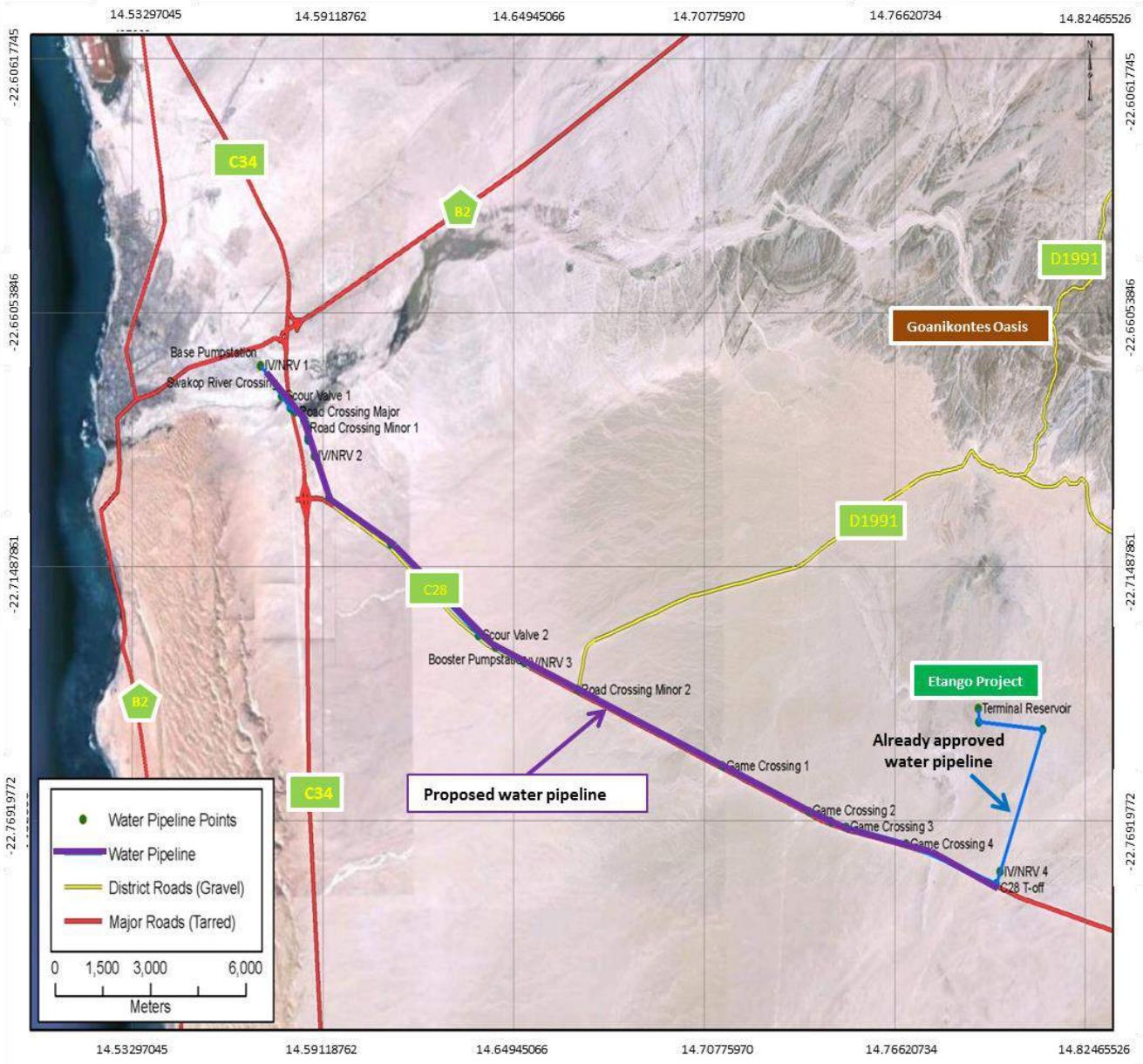
Focus Group Meetings

24 – 25 March 2022

EIA Team

Team	Name	Designation	Tasks and roles	Company
Client	Werner Ewald	Managing Director/ Project proponent	Responsible for the interface between Bannerman and the environmental team, and for ensuring implementation of the EIA / EMP outcomes.	Bannerman Mining Resources (Namibia) (Pty) Ltd
Project management	Alexandra Speiser	Project Manager	Management of the process, team members and other stakeholders. Report compilation. Review	ASEC
	Werner Petrick	Project Management Assistant	Management of the process, team members and other stakeholders. Report review	Namisun
Specialist investigations	John Kinahan	Archaeologist	Conduct archaeological field study	QRS
	Antje Burke	Botanist	Conduct botanical field study	EnviroScience
	Peter Cunningham	Ecologist	Conduct vertebrate fauna field study	Environment and Wildlife Consulting Namibia

Location of the newly assessed water pipeline (purple) and already approved water pipeline (blue).



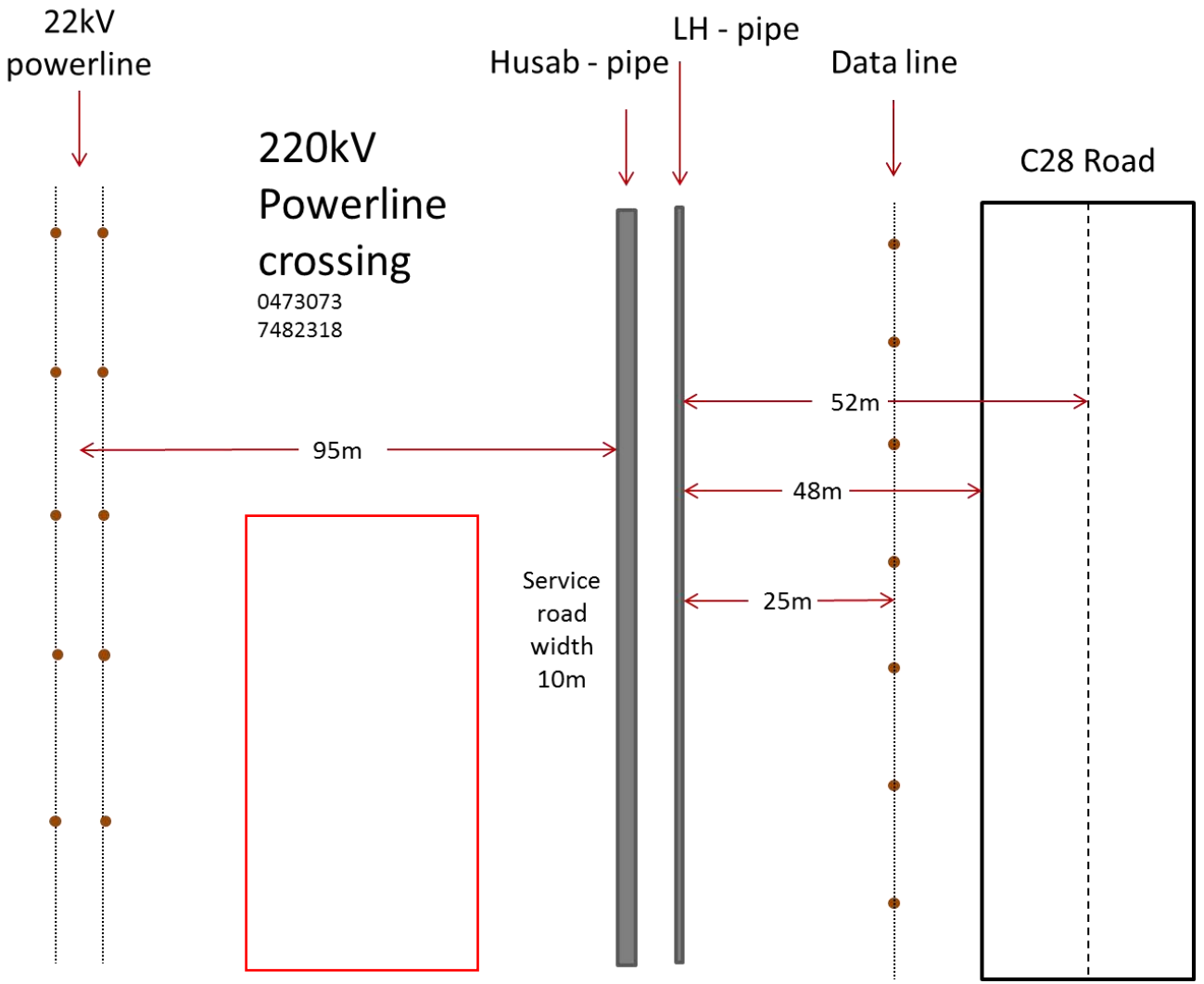
ASEC

BANNERMAN RESOURCES

Background to the Project

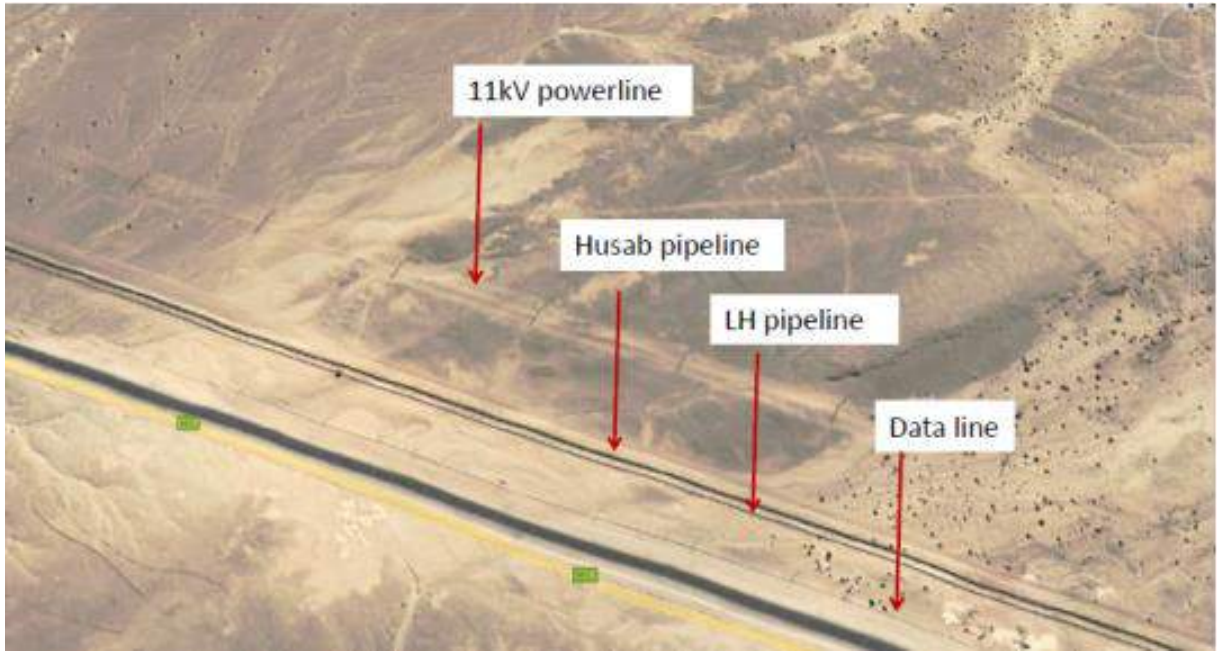
- base pump station near Swakopmund to the Etango Project turn off from the C28) will be ~ 30 km in length and have a diameter of 400 mm.
- Existing pipleines (Langer Heinrich pipeline (south) – 250 mm and Swakop Uranium (Husab Mine) pipeline – 600 mm)
- Discussions with Reptile Uranium regarding the construction of their proposed new Tumas Pipeline – i.e. 3rd pipeline along this pipeline corridor – rather than constructing a 4th pipeline

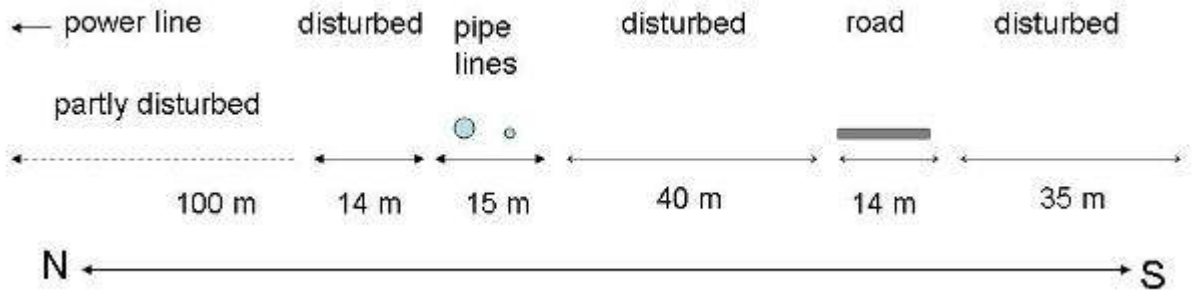
Position of new pipeline(s)



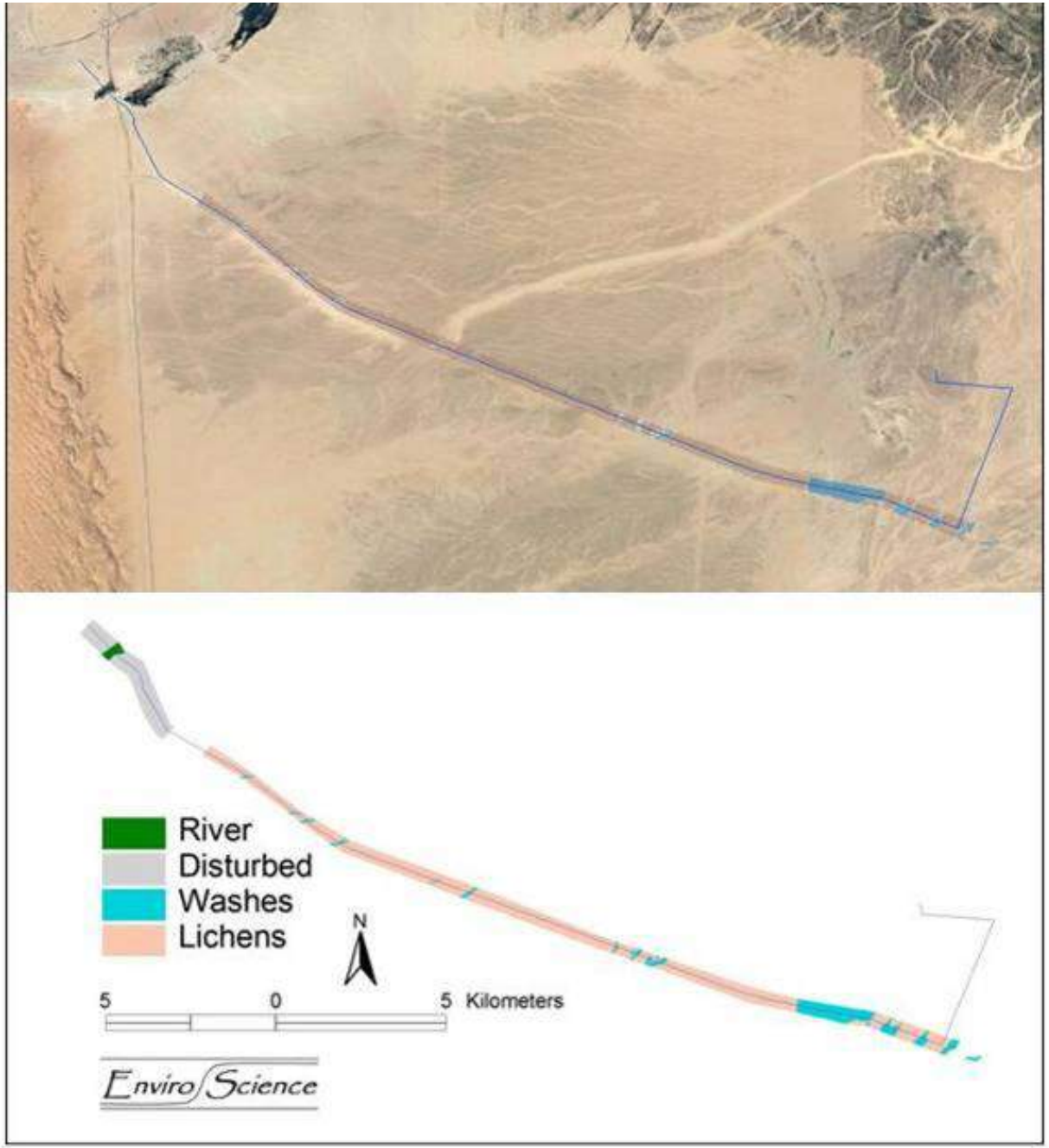
Flora findings

Aerial view and schematic cross section of existing service corridor (not entirely to scale and the measurements are approximates). The distance to the power line running north of the pipelines varies along the route, but is approximately 100 m from the disturbed area in many places.





Extent of lichens, washes and river crossing the pipeline route – depicted with Google Earth backdrop (top) and for better clarity without backdrop (bottom).



Flora impacts & mitigation – during construction

- **Loss of vegetation, lichens and associated biota due to the building of the pipeline**
  - ✓ Reconsider routing pipeline south of existing pipelines
  - ✓ Minimise ground disturbance by stockpiling excavated material in disturbed areas inside service corridor between road and existing pipelines and outside of washes and drainage areas
  - ✓ Backfill excavated areas immediately upon laying of pipeline, should the underground option be taken. However, this will disturb a bigger area, as when the pipeline would be constructed above ground.
  - ✓ Implement special rehabilitation measures where lichen fields are affected (see management guidelines)

- **Loss of vegetation and associated biota due to the construction work force**
  - ✓ House construction staff off-site
  - ✓ Employ environmental staff during construction
  - ✓ Strictly enforce park regulations/rules
  - ✓ Develop and implement Environmental Code of Conduct

Flora impacts & mitigation – during construction

- **Effect of dust on vegetation and lichens**
  - ✓ Use dust suppression measures at dust sources
- **Introduction of invasive alien plants**
  - ✓ Clean underbody and tyres of machinery that was in contact with alien-infested areas
  - ✓ Bring no material (e.g. building sand) from alien-infested sites on site
  - ✓ Monitor sites where additional water could potentially lead to the establishment of invasive alien plants (e.g. where leaks occurred)
  - ✓ Eradicate emerging invasive alien plants

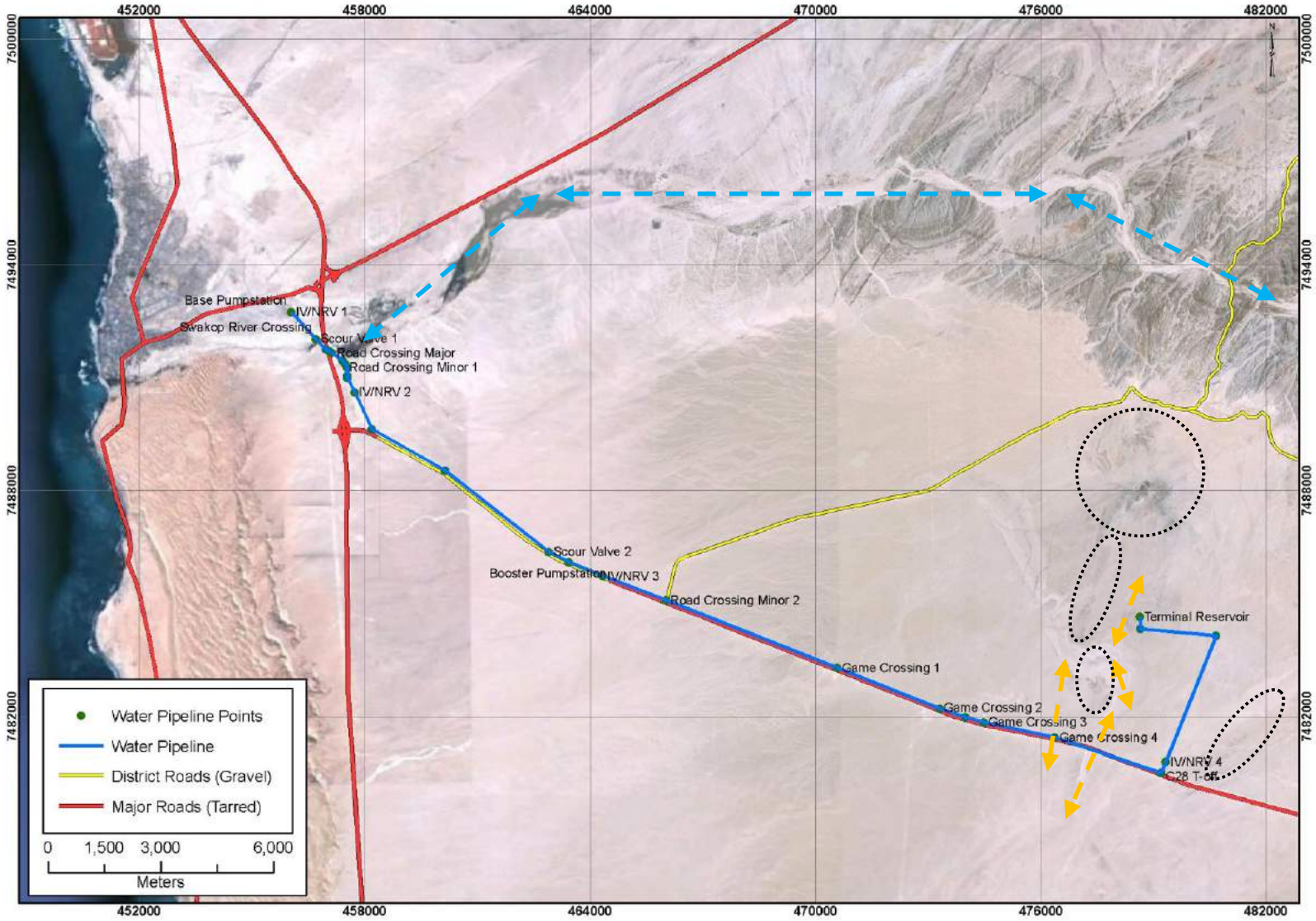
Flora impacts & mitigation – during operation

- **Change of habitat**
  - ✓ Bury pipeline deeper in washes and drainage areas to avoid obstructing water flow and damage by floods

- **Introduction of invasive alien plants**
  - ✓ Regularly check for leaks
  - ✓ Monitor sites for invasive alien plants along pipeline and
  - ✓ Eradicate immediately

Vertebrate Fauna Findings

The most important habitat features in the general area are viewed as the Swakop River and its various tributaries (dashed blue arrows); ephemeral drainage lines (dashed orange arrows) and rocky outcrops/ridges, especially “white geology” as potential habitat for the endemic and range restricted Husab sand lizard (dotted black circles/oblongs). (Source: Google Earth).



Vertebrate Fauna impacts & mitigation

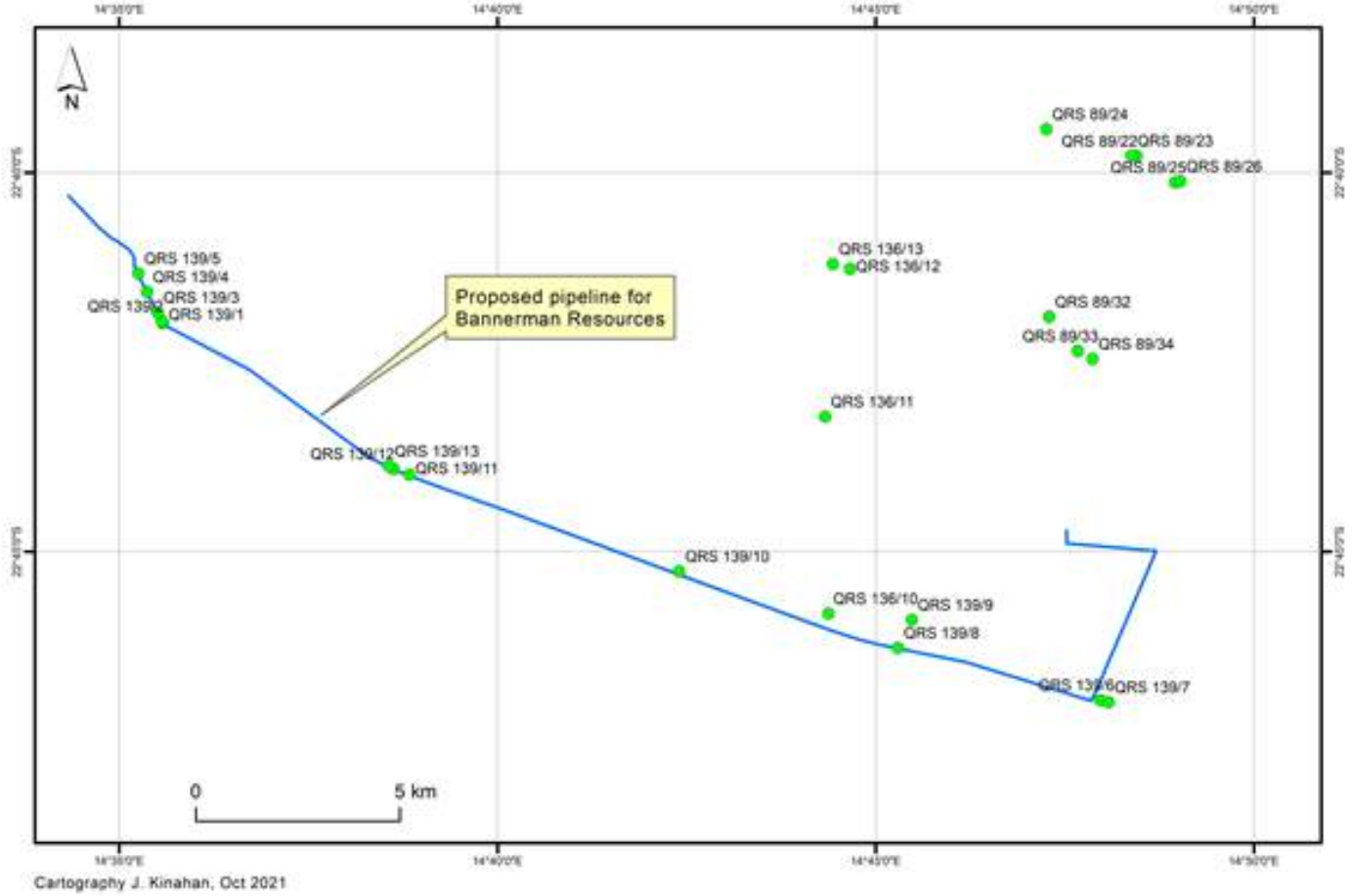
During construction:

- **Vertebrate fauna habitat affected; open trench a pitfall trap and above ground pipeline would affect ungulate and ostrich movement.**
  - ✓ Avoid sensitive habitats – i.e. ephemeral drainage lines,
  - ✓ Liaise with Reptile Uranium to join their proposed pipeline (i.e. 3rd pipeline along pipeline corridor) rather than constructing a 4th pipeline;
  - ✓ Mimic the "wildlife crossing" points along the existing pipelines – i.e. follow the same pipeline corridor;
  - ✓ Leave enough space between the pipelines for maintenance purposes; and
  - ✓ Avoid leaving an open trench overnight and/or leave access routes at each end of the trench.

During operation:

- **Above ground pipeline would affect ungulate and ostrich movement.**
  - ✓ Bury pipeline, where possible (depending on geology) from T/Off north-eastwards to the Terminal Reservoir area.

Archaeological Findings



13 sites were encountered showing isolated MSA levallois unifacial point, hornfels, isolated MSA core and flake, hornfels and chunk of yellow chert with cortex trimming

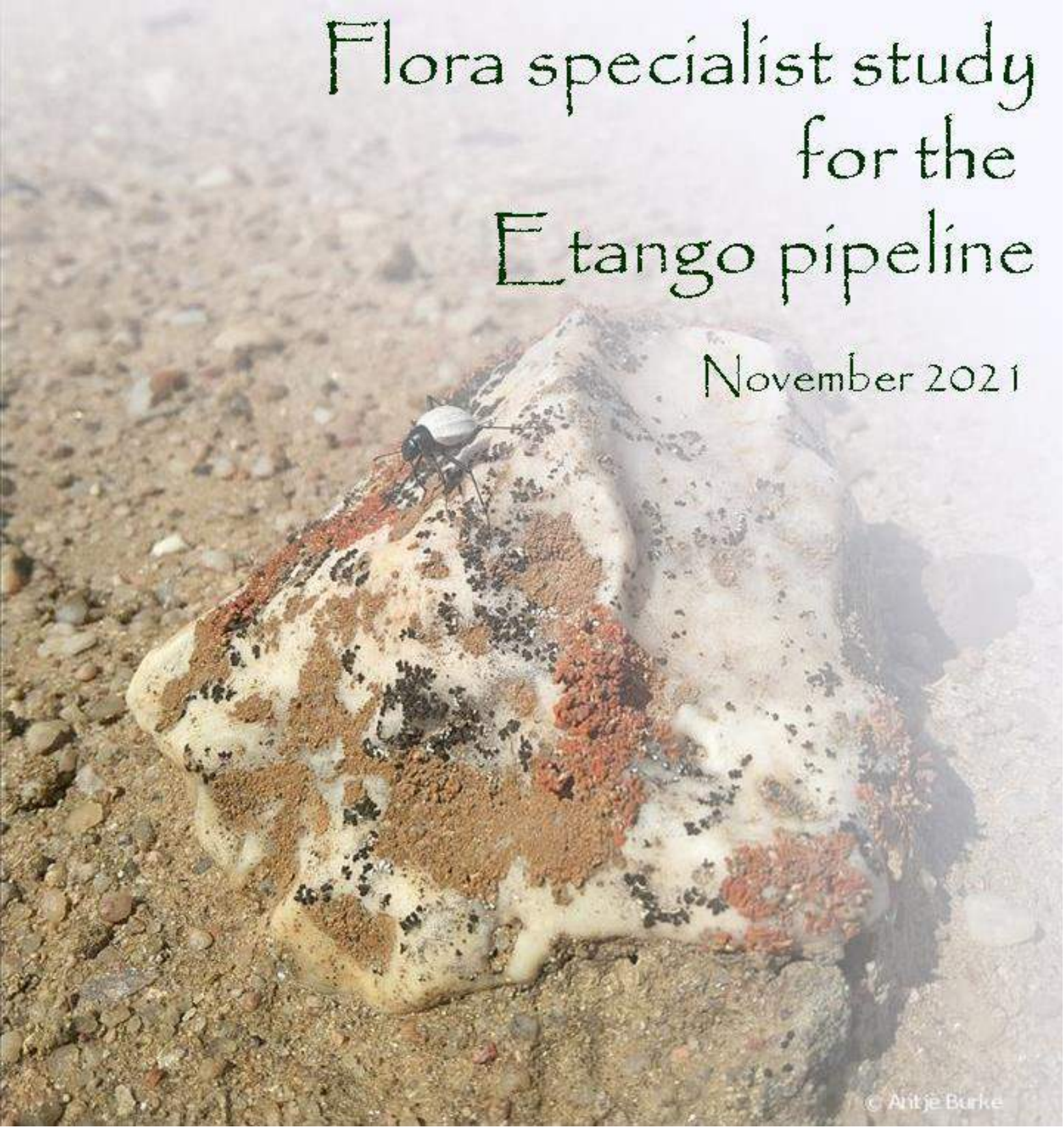
Archaeological impacts & mitigation

- **Disturbance or destruction of ten late Pleistocene Middle Stone Age artefact occurrences and their landscape setting.**
  - ✓No mitigation measures

Appendix F: Flora Specialist Study

Flora specialist study for the Etango pipeline

November 2021



BANNERMAN RESOURCES

A. Speiser Environmental Consultants

Enviro Science

Report prepared by	Dr Antje Burke EnviroScience PO Box 90230 Klein Windhoek Namibia Tel:+264-61-211729 enviroscience@gmx.com
Prepared for	A. Speiser Environmental Consultants and Bannerman Mining Resources (Namibia) (Pty) Ltd
Conditions	Conclusions, statements or original information extracted from this report must be referenced. The report is to be included in its entirety in any subsequent reports that include recommendations from this report.
Citation	Burke A. (2021) Flora specialist study for the pipeline for the Etango project in the central Namib. EnviroScience, Windhoek.
Expertise	Antje Burke is an independent consultant with over 25 years of experience in Environmental Assessments and a specialist on the Namibian flora (see also Annex 2).
Declaration of independence	Neither Antje Burke nor EnviroScience have any business, personal, financial, or other interest in the proposed Project apart from fair remuneration for the work performed. Project information contained herein is based on the interpretation of data provided by the client, accepted in good faith as being accurate and valid.

Acknowledgements. Information from the plant specimens database was provided by the National Botanical Research Institute. Deep Yellow/Reptile Uranium gave permission to use relevant information from the botanical specialist study for the Tums project. Werner Ewald provided important technical information. Alex Speiser provided useful comments. A hearty "thank you" to all.

Summary

1. **Introduction.** Bannerman Mining Resources' Etango project requires a water pipeline from the Swakopmund base pump station to the turn-off to the mine site. The route will follow the existing service corridor along the C28 district road. This report is a botanical specialist study assessing the impacts of the proposed pipeline on flora and vegetation.

2. **Affected habitats, vegetation and flora**. The Swakop River, lichen-covered plains and washes supporting a sparse cover of Namib Desert endemic shrubs – mainly the pencil bush (*Arthraerua leubnitziae*), and dollar bush (*Zygophyllum/Tetraena stapffii*) becoming co-dominant in the eastern section – are the main landscape features.

3. **Impacts on flora and habitats**. The impact assessment identified the following key impacts:

- Loss of vegetation and associated biota
- Effects of dust on vegetation and lichens
- Introduction of invasive alien plant and
- Change of habitat.

4. **Management and mitigation measures.** A minimum footprint overall should be the guiding principle of any development in this arid ecosystem. This can be achieved by the following actions:

Protect biodiversity
- Use the map of lichen extent and washes to guide all planning decisions.
- Protect lichen fields and washes from inadvertent disturbance.
- Maintain ecosystem function by retaining natural water flow.
- Prevent and control spread of invasive alien plants.
- Rehabilitate by closing excavated areas as soon as possible.
- Test restoring lichen fields and biocrusts

Limit footprint
- Limit concrete slabs and foundations to what is absolutely necessary.
- Ensure machinery and vehicles move or park within existing disturbed service corridor.

Prevent pollution
- Prevent pollution of soil and water.
- Implement dust control measures during construction.

Contents

Figures and tables

Chapter 1 Introduction

Bannerman Mining Resources' Etango project requires a water pipeline from the Swakopmund base pump station to the turn-off to the mine site. The route will follow the existing service corridor along the C28 district road. This report is a botanical specialist study assessing the impacts of the proposed pipeline on flora and vegetation.

1.1 Background

Bannerman Mining Resources' Etango project requires a water pipeline from the base pump station near the Swakop River crossing east of Swakopmund to a terminal reservoir near the project site. There is an already existing water pipeline and power line service corridor, following the alignment of the C28 district road.

This pipeline will likely be partly shared with Reptile Uranium's Tumas project.

The route alignment therefore overlaps to some extent with Reptile Uranium's proposed water pipeline route. EnviroScience undertook a field survey along the Tumas project's pipeline route in May 2021 from the Tumas site up to some 20 km east of Swakopmund. As the Tumas project pipeline is proposed to run in an existing service corridor, the Tumas field survey focused on establishing the extent of the *Welwitschia mirabilis* subpopulations in this service corridor and stopped when no more Welwitschias were encountered.

1.2 Terms of reference

This botanical specialist study assesses the impacts on the flora associated with the new proposed pipeline. The spatial scope is from the Swakopmund pump station to the C28 T-turn off to the Etango project. The section from the C28 T-turn-off to the site had been assessed in a previous environmental study (ERM 2011).

1.3 Study area

The study area is positioned partly in town lands and partly in the northern section of the Namib-Naukluft Park in the Erongo Region in Namibia (Figure 1). The pipeline starts at the Namwater Swakopmund pump station and follows the C28 district road for some 27 km eastwards to the C28 T-turn off to the Etango project site.

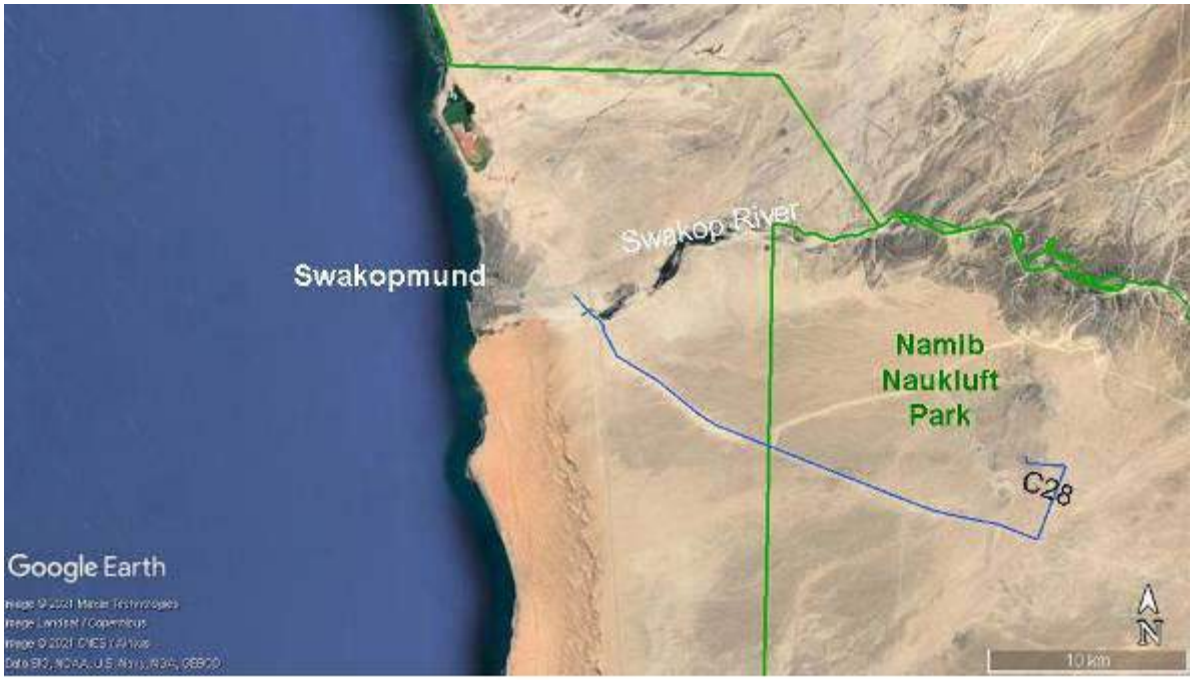


Figure 1A. Position of planned pipeline in the Namib-Naukluft Park and Erongo Region of Namibia.

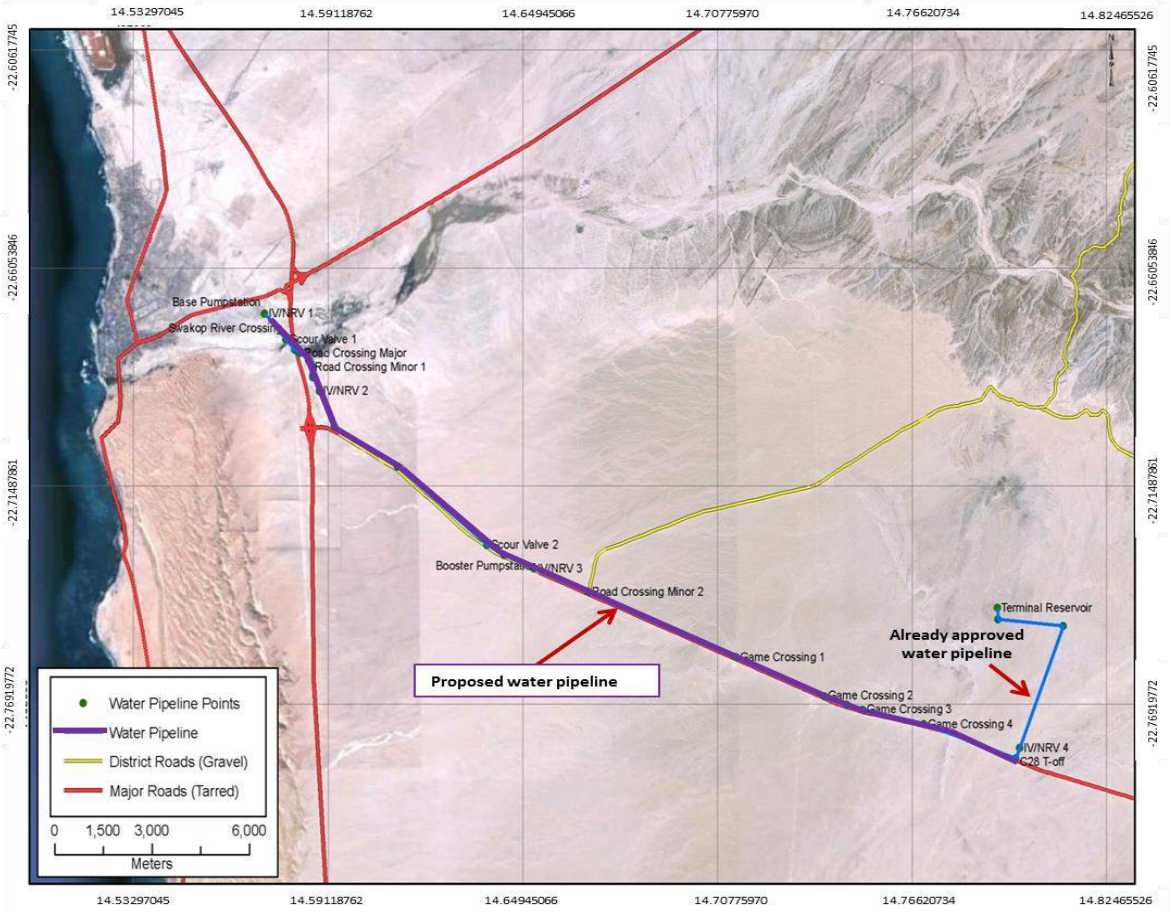


Figure 1B. Pipeline route in more detail (map provided by Bannerman Mining Resources).

Climate

The climate in the project area is arid and falls into southern Africa's summer-rainfall region. Although mean annual rainfall is in the region of only about 20 mm, regular fog is observed up to 60 km inland and may exceed rainfall in this area (Hachfeld & Jürgens 2000).

Landforms and vegetation

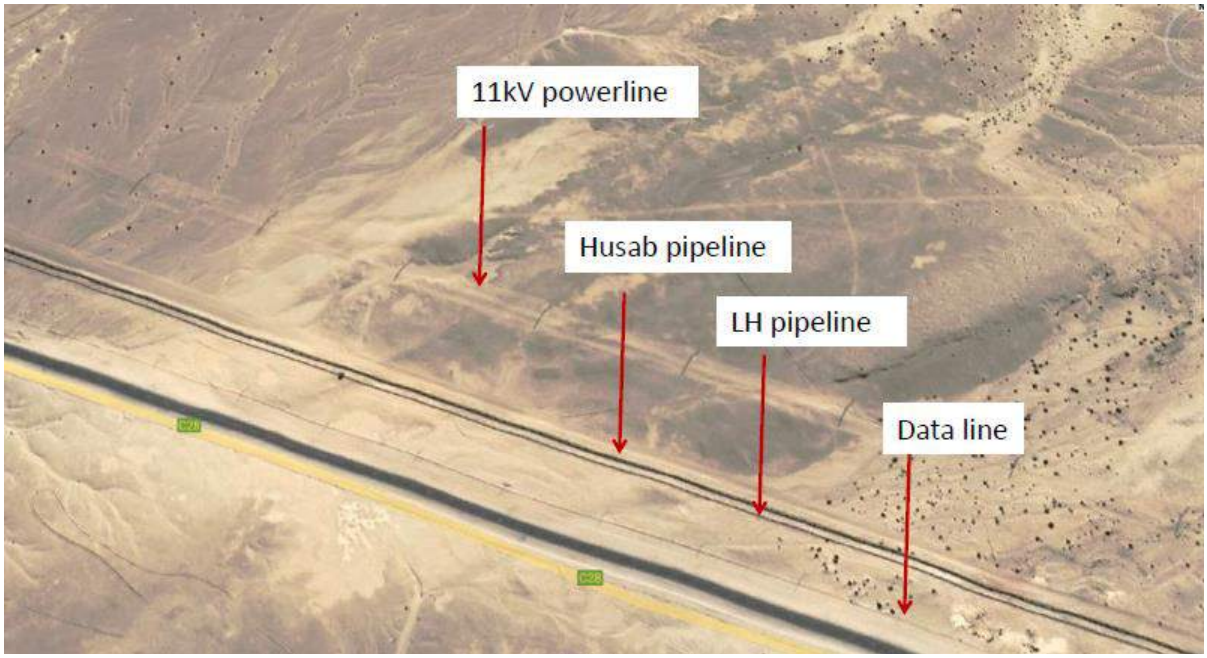
Plains, shallow and wide washes, hills and ridges characterise the study area. Quartz gravel and other rock debris cover most of the plains and hills, and sand dominates in the rivers and washes. Soils are mostly shallow lithosols and where gypsum and other salts are prominent at the surface, crusts develop. The gypsum-rich soils (gypsisols) and gravel plains support extensive lichen fields. These are species-rich and support all growth forms of lichens from unattached, ground-dwelling, rock-attached to leafy forms.

Figure 2. Gypsum-rich soils form crusts in the study area and support an unique and diverse assemblage of lichens.

Land use and existing infrastructure

Land use in the project area is wildlife conservation and tourism. The investigated service corridor already contains two water pipelines, a power line and the C28 district road. So this is by no means virgin territory.

However, as most of the infrastructure was established more than 10 years ago, and the newer water pipeline to the Husab Mine included rehabilitation, the service corridor has to some extent recovered and is not completely devoid of vegetation, but has not shown any recovery of lichens.



(Provided by Bannerman Mining Resources)

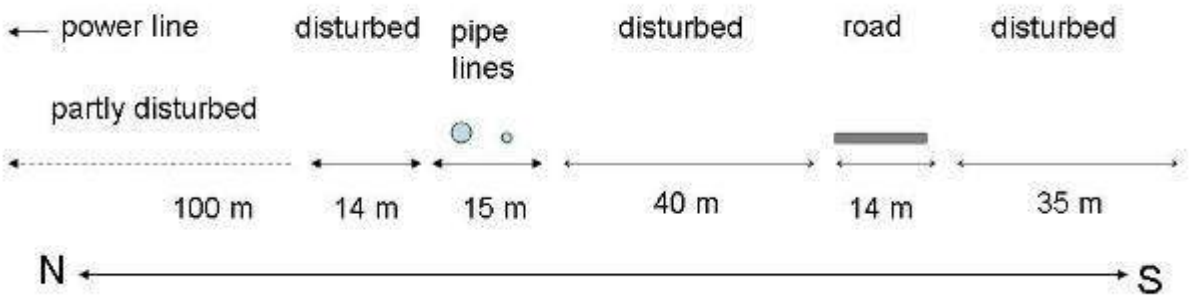


Figure 3. Aerial view and schematic cross section of existing service corridor (not entirely to scale and the measurements are approximates). The distance to the power line running north of the pipelines varies along the route, but is approximately 100 m from the disturbed area in many places.

The area beneath the power line (beyond the 14 m disturbed area north of the pipelines) is in many places undisturbed or has recovered. Even lichens occur in some sections.

1.4 The proposed new pipeline

In order to satisfy the water demand of both the Tumas and Etango project an additional pipeline is required. The pipeline will be 400 mm in diameter and is scheduled to initially deliver 2.4 million m^3 per year. The volume could go up to 5 million m^3 per year in later stages of the project and the 400 mm pipeline already caters for this volume.

Unlike the existing two pipelines, the new pipeline will be buried wherever possible, but will be routed above-ground where blasting would be required (W. Ewald, pers. comm. October 2021).

Discussions with engineers and (former) Namwater staff indicate that the pipeline will likely have to be routed north of the existing two pipelines and not south between the existing pipelines and the road (Figure 4).

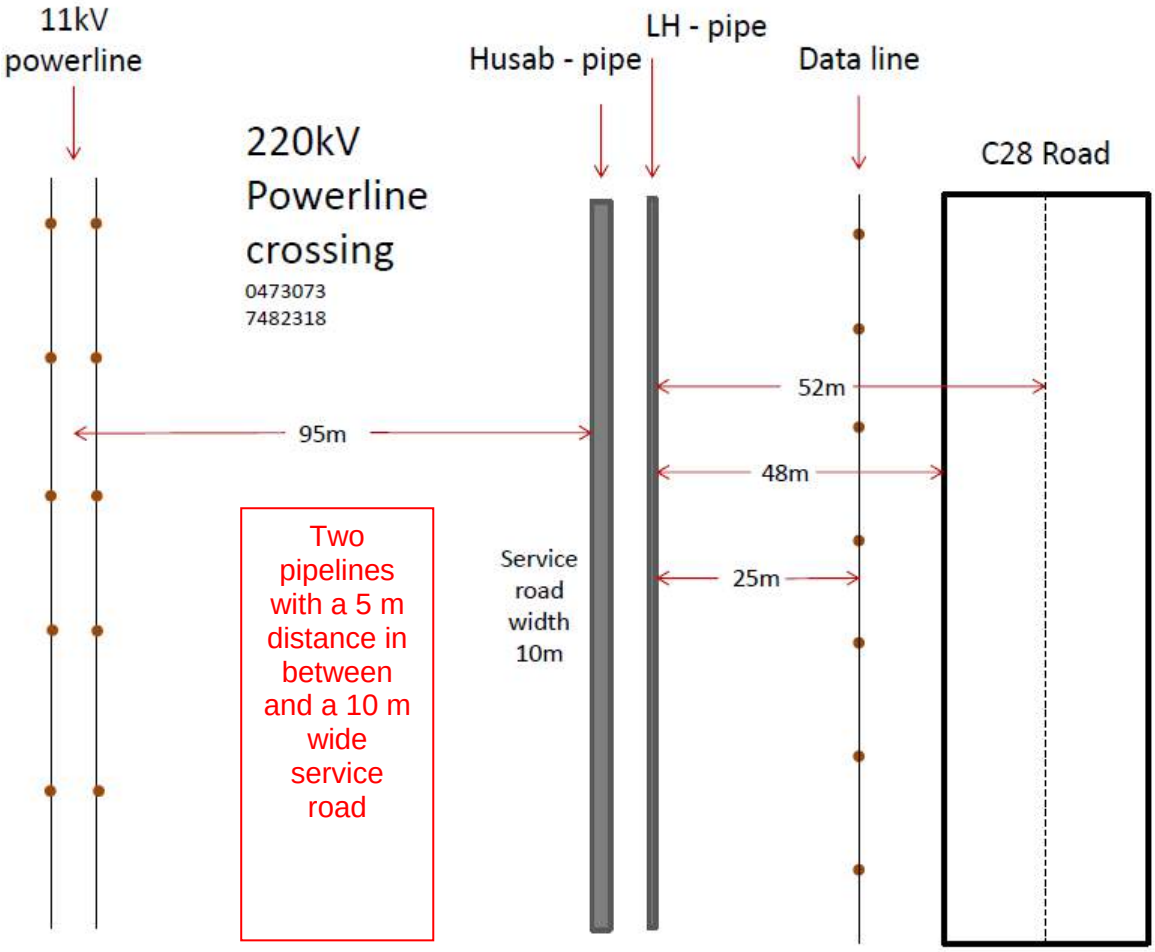


Figure 4. Worst case scenario of two water pipelines required for Etango and Tumas project positioned north of the existing pipelines.

1.5 Legal, policy and other requirements

Table 1 lists the applicable legislation, policies and other requirements relevant to the project. Legislation directly related to flora are the Forest Act, Nature Conservation Ordinance and Cites. These govern the legal protection and trade with particular plant species. Protected plants that need to be removed as part of the project development require a permit from the Forestry Directorate in the Ministry of Environment, Forestry and Tourism.

Other legislation of relevance is cited here because it may regulate secondary impacts on the flora.

Table 1. Applicable legislation, policies and other requirements (legislation directly related to flora is indicated in bold dark green font). .

Legislation	Applicable provisions
MINING LEGISLATION	
Mineral Act, 1992	Rehabilitation requirements, environmental status prior to mining/prospecting, pollution control measures, liability for pollution
Minerals (Prospecting and Mining) Amendment Act, 8 of 2008	Requirement of EMPR
ENVIRONMENTAL LEGISLATION	
Environmental Management and Assessment Act 7 of 2007; List of activities that may not be undertaken without Environmental Clearance Certificate, GN 29 of 2012; Environmental Impact Assessment Regulations, GN 30 of 2012	Requirements for and process of environmental assessments
Draft Regulations for Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA), 2008 and Draft procedures and guidelines for Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP), 2008	Contents of strategic environmental assessments, Environmental Impact Assessments and Environmental Management Plans
Namibian Constitution Section 95(l)	Use of natural resources, protection of environment, biodiversity and ecosystems
Atmospheric Pollution Prevention Ordinance, 11 of 1976, prohibition of the import of ozone depleting substances, GN 281, 31 December 2010	Permitting of fuel burning appliances, prohibition of ozone-depleting substances Dust management
Atomic Energy and Radiation Protection Act, 5 of 2005; 1A.1 Radiation Protection and Waste Disposal Regulations, GN 221 of 18 November 2011	Handling, transport and disposal of radioactive substances
Water Act, 54 of 1956	Permitting for industrial effluents
Water Resources Management Act, 11 of 2013 (not in force yet)	Protection, development and management of water resources; licencing water abstraction, protection of groundwater, water pollution control, obstruction of watercourses, control and use of wetlands
Forest Act, 12 of 2001 and regulations	**Protected trees, permit for mining in forested areas and cutting of trees and shrubs within 100m from river, stream or watercourse, list of protected trees and shrubs**
Nature Conservation Ordinance, 4 of 1975	**List of protected plant species, provisions for dealing with protected plants**

Legislation	Applicable provisions
Draft Bill Wildlife and Protected Areas Management (version March 2021)[1]	**List of protected species, permit requirements to raise, transport and trade in protected plants**
INTERNATIONAL CONVENTIONS AND PROTOCOLS	
Convention on Biological Diversity, 1992	Protection of biodiversity
United Nations Framework Convention on Climate Change, 1992 13.1 Kyoto Protocol, 1997	No legislation promulgated yet to meet proposed guidelines
Convention on International Trade with Endangered Species (CITES)	**Internationally accepted list of plant and animals species with trade restrictions**
STRATEGIC ENVIRONMENTAL ASSESSMENT FOR NAMIBIA'S URANIUM PROVINCE	
Environmental quality objective 02 – Mine closure	Development of a mine closure plan
Environmental quality objective 08 – Ecological integrity	Submission of all information related to environmental matters to MEFT and the SEMP office at MME

1.6 Approach

A field survey of the section of the route from the Swakopmund pump station to the C28 T-turn off to the Etango project was carried out on 11 October 21. Habitats, condition and sensitive areas were mapped within an approximately 500 m corridor to both sides of the proposed route. As this was a dry-season survey, available plant information for the general area was also reviewed and included where appropriate.

The field information was summarised in a map showing the extent of the lichen fields, habitat features and particular habitats to be considered during the construction of the pipeline.

The impact assessment followed the methodology provided by Namisun and prescribed for the Tumas project (see Annex 1), which has been adopted by ASEC for the Bannerman pipeline project after discussion with Namisun.

[1] Not yet promulgated.

Chapter 2 Affected habitats, vegetation and flora

The Swakop River, lichen-covered plains and washes supporting a sparse cover of Namib Desert endemic shrubs – mainly the pencil bush (*Arthraerua leubnitziae*), and dollar bush (*Zygophyllum/Tetraena stapffii*) becoming co-dominant in the eastern section – are the main landscape features.

2.1 Habitats and vegetation along the pipeline route

The service corridor crosses a largely level landscape with extensive plains which are dissected by a network of dry washes and rivers. These cross the pipeline route mostly in a north-northeast to south-southwest draining direction. The exception is the crossing of the large Swakop River which drains east to west.

Outside the Swakop River the vegetation is very sparse (< 1 % cover) and grows not more than 0.5 m in height. Perennial vegetation (shrubs and multi-seasonal herbs) mostly grow in washes and depressions; that is any areas that receive run-off from the rare rain events.

The pencil bush (*Arthraerua leubnitziae*), a Namib Desert endemic, is the dominant shrub along the entire pipeline route. The dollar bush (*Zygophyllum stapffii*), another Namib Desert endemic, starts to become co-dominant in the eastern section of the route.

Gypsum-rich soils and gravel plains support a great diversity of ground-dwelling lichens and extend almost along the entire route to both sides of the service corridor. Microphytic crusts (biocrusts) composed of algae, cyanobacteria, fungi and lichens also form in patches along the entire route in undisturbed areas.

Swakop River

The Swakop River is the only area with dense vegetation, largely composed of tamarisk trees (*Tamarix usneoides* and *T. ramosissima*) and reeds (*Phragmites australis). Tamarix ramosissima* is exotic, while *T. usneoides* is the indigenous tamarisk which would normally dominate in this dry riverbed. The exotic tamarisks are problem plants in other parts of the world but have not yet been classified as invasive in Namibia (Klaassen & Kwembeya 2013). However, the Swakop River also contains many other invasive aliens such as wild tobacco (*Nicotiana glauca*), thorns apple (*Datura* species), Mexican poppy (*Argemone ochroleuca*) and castor oil bush (*Ricinus communis*).

Figure 5. Existing pipelines crossing the Swakop River.

Washes

Washes support more diverse and larger vegetation which, in addition to *Arthraerua leubnitziae* and *Zygophyllum stapffii* also include shrubs such *Galenia africana, Gomphocarpus filiformis* and the tuberous *Citrullus eccirrhosus*. These are accompanied by a variety of herbs and grasses after rain events.

One area along the route seemed to have received some run-off a few months before the field survey and additional species observed were the small succulents *Sesuvium sesuvioides* and *Zygophyllum simplex*, the Namib endemic herb *Senecio engleranus* and the grass *Stipagrostis ciliata*.

Although no *Welwitschia mirabilis* plants grow along the route section from Swakopmund to the C28 T-turn off to the Etango project site, *Welwitschia* plants start occurring just beyond the turn-off and also along the t-off section. These plants have been mapped and included in the previous assessment (ERM 2011).

Figure 6. Washes and depressions along the pipeline route support denser vegetation – here mostly dollar bushes (*Zygophyllum/Tetraena stapffii*).

Plains and lichen fields

Except for the first 5 km of the route from the pump station, lichen[2] fields are present on both sides of the pipeline route in an almost continuous cover, starting immediately outside the service corridor. These lichen fields are only interrupted by washes and larger, wide drainage areas. Lichens mostly grow on gravel and rocks, but cover is continuous, although changing in density across the landscape. Habitats receiving more moisture such as slight rises, ridges and hills usually show a denser cover of lichens than the more level areas. Where lichens occur, there are also often biotic crusts comprised of cynaobacteria, algae and fungi.

This part of the central Namib supports one of the most species-rich lichen fields on the planet. Many of these species are endemic to the Namib Desert and all possible life forms of lichens are present (crustose, foliose, fruticose, saxicolous, vagrants) (Wirth 2010).

[2] Taxonomically speaking, lichens are not plants, but a life form composed of two organisms, algae and fungi species. Algae are plants, but fungi have their own kingdom now. However, lichens are included here as part of the botanical assessment.

Figure 7. The dark areas on the left photo are lichen fields. Taking a closer look (right photo) they reveal an astonishing diversity of lichens.

Marble ridge

One low, N-S trending marble ridge starts south of the service corridor. Unlike many other marble ridges further inland, no additional species of particular conservation importance were observed, at least not in the vicinity of the service corridor.

2.2 Environmentally sensitive areas

Even in the context of working in a disturbed service corridor, there is still merit in pointing out particular habitats as environmentally sensitive. The washes and drainage areas which run across the pipeline route are such sensitive areas, as they support denser vegetation and, if these are permanently disturbed, would also alter flow patterns and thereby have secondary affects on vegetation downstream.

The lichen-covered plains, ridges and hills along the pipeline route, are environmentally sensitive areas as these are extremely slow to recover, if at all (Lalley & Viles 2006). For example no recovery has taken place in the service corridor around the existing pipelines and between the road and the pipelines. Lichens are also indicators for microphytic crusts (biocrusts). These crusts are formed by a mix of cyanobacteria, algae, fungi and mosses and are important soil stabiliser and fertilisers in deserts (e.g. Bell 1993; Eldridge & Greene 1994). Sections of lichen fields are present between the two existing pipelines and the power line. These were either not disturbed during the construction of the power line, where ground disturbance is more localised, or lichens have recovered, as the power line has been present for much longer than the pipelines.

2.3 Flora

On a plant species level, only one protected species, the tree *Tamarix usneoides* was encountered along the investigated section of the route. No red-list or Cites species were recorded. The protected *Welwitschia mirabilis* grows near the C28 T-turn off from the service corridor to the mine though.

The dominant plants in this area are, however, Namib Desert endemics and therefore have a restricted distribution range. So even if they are abundant in the study area, one has to remember that the Namib Desert is the only place in the world where they occur. Many more endemic species, particularly bulbs and herbs are likely to emerge after rains.

Figure 8. The Namib endemic herb *Senecio engleranus* was in full bloom in one of the washes, probably as a result of a localised shower a few months prior to the fieldwork.

Figure 9. Lichens do not grow in the disturbed service corridor around the pipelines and between road and the pipelines. Yet they have recovered in some sections under the power line, or were not left in places undisturbed during the construction of the power line.

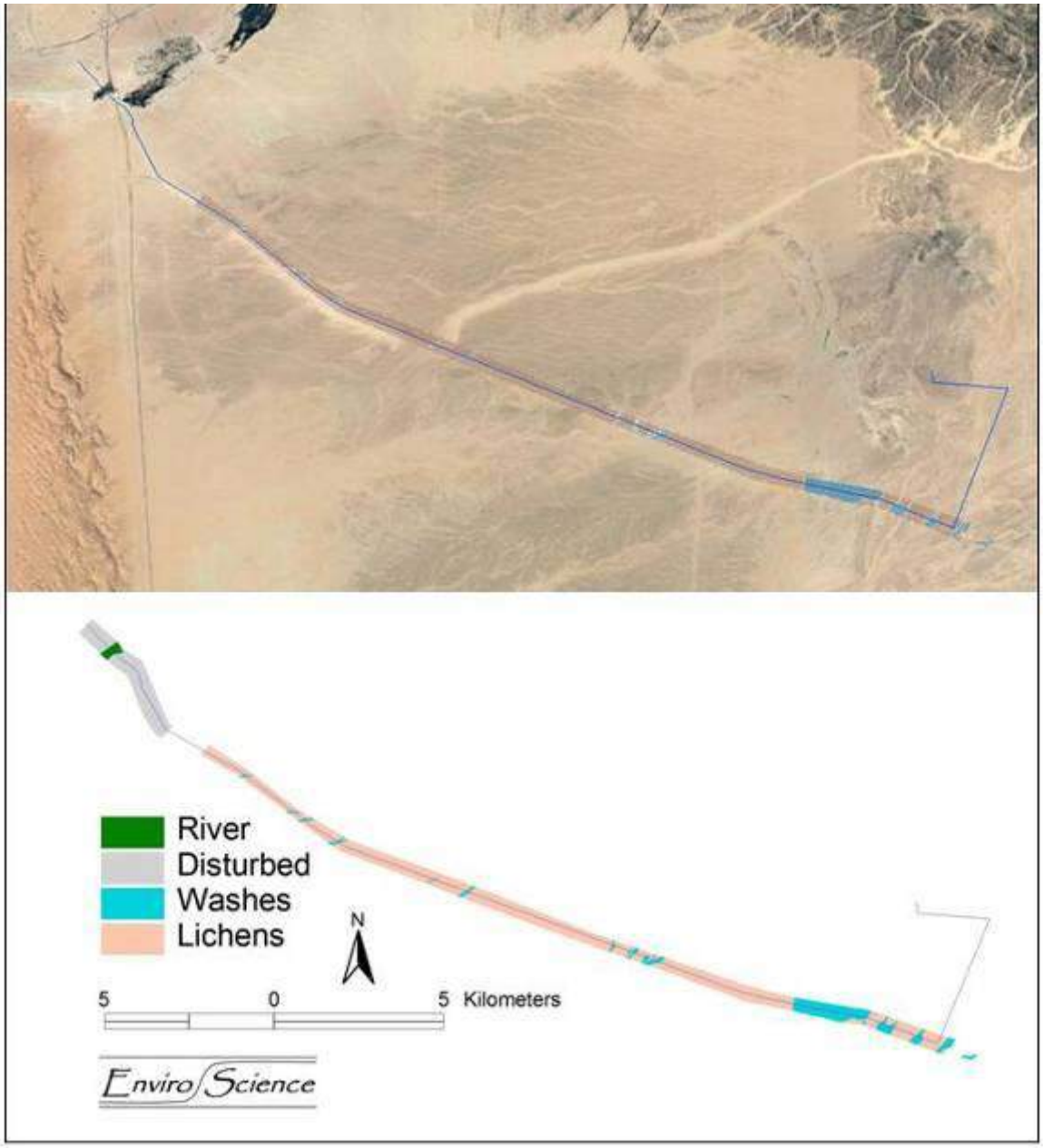


Figure 10. Extent of lichens, washes and river crossing the pipeline route – depicted with Google Earth backdrop (top) and for better clarity without backdrop (bottom).

Chapter 3 Impacts on flora and habitats

The impact assessment identified the following key impacts:

- Loss of vegetation and associated biota
- Effects of dust on vegetation and lichens
- Introduction of invasive alien plant and
- Change of habitat.

As indicated in the introduction the new pipeline will be constructed in an already disturbed service corridor. However, even along this corridor there are areas which are more environmentally sensitive than others. Within the service corridor these are the washes and drainage areas and section of lichen fields; outside the service corridor, these are the lichen-covered plains and hills.

All potential negative impacts are assessed without mitigation and then with mitigation. The impact assessment criteria are provided in Annex 1. The following assumptions were made:

- The pipeline is routed underground, as far as possible.
- The route will follow the existing service corridor along the C28.

Impacts with mitigation measures applied assume that all measures are implemented and are effective. The assessment with mitigation measures is provisional as the effectiveness of the measures is only known after implementation. Impacts are described during construction and during operation.

Two scenarios are presently likely:

1. Two pipelines north of the existing pipelines to accommodate both the Etango and Tumas projects separately and
2. one pipeline north of the existing pipelines jointly used by the Etango and Tumas project.

Although the footprint will be larger for the two-pipeline scenario as a 10 m wide service corridor is required and a gap of 5 m between the two lines, it does not affect the rating in the impact assessment.

3.1 Impacts during construction

1. Loss of vegetation, lichens and associated biota due to the building of the pipeline	
Impact description	The excavation for the pipeline requires the clearing of some vegetation, mainly in washes. This means a loss of perennial vegetation which provides an important habitat and food source for animals. The pipeline is planned to be constructed north of the two existing pipelines and

	this would infringe partly on undisturbed area, particularly some sections of lichen fields.	
Intensity: Moderate Natural processes are altered, because vegetation cover will be reduced, section of lichen field will be disturbed	Extent: Low Local, affects only small section of washes and parts of lichen fields	Duration: High, as vegetation will recover in washes after rains, but lichens take a very long time to recover if at all
Consequence: Moderate	Probability: Very high The pipeline crosses several washes and drainage areas area, and lichens start north of the two existing pipelines	Significance: High

Assessment assuming that all mitigation measures are effectively implemented:

1. Loss of vegetation and associated biota due to the building of the pipeline		
Mitigation measures	• Reconsider routing pipeline south of existing pipelines • Construct pipeline belowground as far as possible and bury deeper when crossing washes • Minimise ground disturbance by stockpiling excavated material in disturbed areas inside service corridor between road and existing pipelines and outside of washes and drainage areas • Backfill excavated areas immediately upon laying of pipeline • Implement special rehabilitation measures where lichen fields are affected (see management guidelines)	
Intensity: Moderate Natural processes will remain altered in some areas	Extent: Low Local	Duration: High, vegetation will recover in washes after rains, but lichens take a very long time to recover, if at all
Consequence: Moderate	Probability: Moderate, if restoration of lichen fields is successful	Significance: Moderate

2. Loss of vegetation and associated biota due to the construction work force		
Impact description	Construction workers collect firewood and kindling in the Swakop River	
Intensity: Moderate; without controls people will be collecting firewood	Extent: Low Local, confined to project area	Duration: Moderate Appropriate management can reverse this impact
Consequence: Moderate	Probability: Moderate	Significance: Moderate

Assessment assuming that all mitigation measures are effectively implemented:

2. Loss of vegetation and associated biota due to the construction work force		
Mitigation measures	• House construction staff off-site • Employ environmental staff during construction • Strictly enforce park regulations/rules • Develop and implement Environmental Code of Conduct	
Intensity: Moderate	Extent: Low Local, confined to project	Duration: Moderate Appropriate management

	area	can reverse this impact
Consequence: Low	Probability: Low	Significance: Low

3. Effect of dust on vegetation and lichens		
Impact description	Dust is created during the excavation to place the pipeline underground and when support pillars are erected for the above-ground section of the pipeline	
Intensity: Moderate Natural processes continue in an altered way, as photosynthesis will be reduced in dust-covered vegetation	Extent: Low Very local, confined to limited areas within project area	Duration: Low Likely reversible after rainfall events
Consequence: Low	Probability: Moderate	Significance: Low

Assessment assuming that all mitigation measures are effectively implemented:

3. Effect of dust on vegetation and lichens		
Mitigation measures	• Use dust suppression measures at dust sources	
Intensity: Moderate Natural processes continue in an altered way	Extent: Low Very local, confined to limited areas within project area	Duration: Low Likely reversible after rainfall events
Consequence: Low	Probability: Moderate	Significance: Low

This is likely more of a human-health aspect than an impact on biodiversity, and mitigation measures should be employed, even if this does not change the impact rating.

4. Introduction of invasive alien plants		
Impact description	The movement of machinery and materials could result in introducing invasive alien plants such as *Datura* sp., *Nicotiana glauca* and *Prosopis* sp. This is particularly a concern if material/machinery which has been in touch with infested areas, e.g. in the Swakop River, moves onto site.	
Intensity: High Natural processes are altered, because indigenous vegetation is suppressed	Extent: Low Local, confined to project area	Duration: Moderate Appropriate management can reverse this impact
Consequence: Moderate	Probability: Moderate, without controls seeds will likely be brought in with vehicles and machinery	Significance: Moderate

Assessment assuming that all mitigation measures are effectively implemented:

4. Introduction of invasive alien plants	
Mitigation measures	• Clean underbody and tyres of machinery that was in contact with alien-infested areas • Bring no material (e.g. building sand) from alien-infested sites on site • Monitor sites where additional water could potentially

	lead to the establishment of invasive alien plants (e.g. where leaks occurred) • Eradicate emerging invasive alien plants	
Intensity: High Natural processes are altered	Extent: Low Local, confined to project area	Duration: Moderate Appropriate management can reverse this impact
Consequence: Moderate	Probability: Low	Significance: Low

3.2 Impacts during operation

5. Change of habitat		
Impact description	The underground pipeline may block some natural water flow, and thereby affect vegetation downstream.	
Intensity: High Natural processes are altered, because water flow is locally altered	Extent: Low Local	Duration: High Long-term to permanent
Consequence: Moderate	Probability: High	Significance: Moderate

Assessment assuming that all mitigation measures are effectively implemented:

5. Change of habitat		
Mitigation measures	• Bury pipeline deeper in washes and drainage areas to avoid obstructing water flow and damage by floods	
Intensity: Moderate Natural processes are altered, water flow locally altered	Extent: Low Local, confined to project area	Duration: Low
Consequence: Low	Probability: Low	Significance: Low

6. Introduction of invasive alien plants		
Impact description	Leaks along the water pipeline can encourage the growth of invasive alien plants.	
Intensity: High Natural processes are altered, because invasive plants suppress indigenous vegetation	Extent: Low Local, confined to project area	Duration: Moderate Appropriate management can avoid or reverse this impact
Consequence: Moderate	Probability: Moderate	Significance: Moderate

Assessment assuming that all mitigation measures are effectively implemented:

6. Introduction of invasive alien plants		
Mitigation measures	• Regularly check for leaks • Monitor sites for invasive alien plants along pipeline and • Eradicate immediately	
Intensity: Low	Extent: Low Local, confined to project area	Duration: Low Appropriate management reverses this impact
Consequence: Low	Probability: Low	Significance: Low

3.3 Comparison of routing options

During the initial discussions with the proponent the routing the new pipeline(s) south of the existing pipelines was discussed at length. Although it is presently considered technically not feasible because of permit and practical issues, it is by far preferable from an environmental point. This section of the service corridor is completely disturbed and vegetation has only recovered to some extent in washes. No lichens have re-established anywhere in this section of the service corridor.

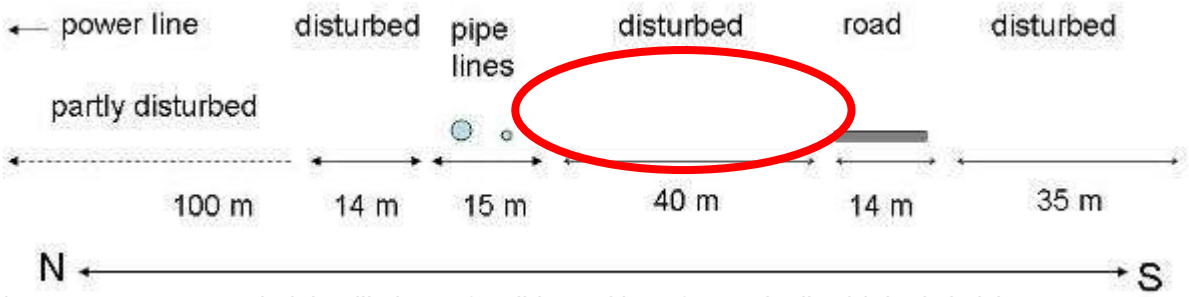


Figure 11. Recommended, but likely not feasible position of new pipeline(s) (red circle).

3.4 Cumulative impacts and their management

Invasive alien plants

From botanical point of view, an additional pipeline increases the risk of water leaks and thereby the chances of invasive alien plants to establish. This is an aspect that can be managed, if the line is regularly inspected and unwanted invasive plants are immediately eradicated – not only along the new pipeline, but also the two existing ones.

Not all plants emerging at leaks are invasive aliens, though and indigenous plants do not need to be eradicated. Leaks should nevertheless be stopped and the areas monitored to ensure emerging invasive alien plants are immediately eradicated.

Figure 12. Invasive alien plants spring up where there are leaks along the pipeline – here a mesquite (*Prosopis* species) at left and wild tobacco (*Nicotiana glauca*) on the right.

3.5 Overall impact statement

From a botanical point of view there is no reason to stop the project, but impacts should be minimised in this fragile arid landscape. Management actions to achieve this are described in the following chapter. One pipeline serving both the Etango and the Tumas project would be preferable to the construction of two pipelines parallel to each other.

An effort should be made to test restoring lichen fields and biocrusts where these will be impacted by the pipeline. Re-establishing biocrusts is practiced in many arid areas as their important ecological function has been recognised (e.g. Antonika et al. 2018; Chiquoinne et al. 2016) and this should therefore also be tested in the central Namib.

3.6 Shortcomings

The fieldwork took place during the dry season and the plant inventory is therefore incomplete. However, as lichen fields can be recognised all year round and the majority of the to-be impacted area is already disturbed, this shortcoming does not affect the assessment.

Chapter 4 Management and mitigation measures

A minimum footprint overall should be the guiding principle of any development in this arid ecosystem. This can be achieved by the following actions:

Protect biodiversity
- Use the map of lichen extent and washes to guide all planning decisions.
- Protect lichen fields and washes from inadvertent disturbance.
- Maintain ecosystem function by retaining natural water flow.
- Prevent and control spread of invasive alien plants.
- Rehabilitate by closing excavated areas as soon as possible
- Test restoring lichen fields and biocrusts.

Limit footprint
- Limit concrete slabs and foundations to what is absolutely necessary.
- Ensure machinery and vehicles move or park within existing disturbed service corridor.

Prevent pollution
- Prevent pollution of soil and water.
- Implement dust control measures during construction.

Surviving with the meagre amounts of water available to desert plants, certainly deserves respect and every plant is therefore important. Many small shrubs, for example take decades to reach half a meter height and recovery of disturbed and cleared vegetation is therefore a long-term process, often far exceeding a human generation. In the context of the planned pipeline, minimising the 'footprint' is therefore critical.

Environmental aspects need to be firmly integrated with all policies, performance measures, inductions and briefings of employees and contractors to ensure successful implementation of measures to protect the environment.

4.1 Minimising footprint

► Linked to impacts 1 and 2

- Construct pipeline belowground as far as possible.
- Construct pipeline in already disturbed service corridor as far as possible.
- Demarcate lichen areas before construction, where these would be crossed by the pipeline(s).
- Implement additional rehabilitation measures in lichen areas that will be disturbed. These are:
  - Harvest lichens, lichen-covered rocks and top 1 cm of soil and store as inoculating medium for restoration.
  - Strip remaining topsoil (1-10 cm depth) where excavations are necessary, and

- store nearby in disturbed area.
- Re-apply topsoil on disturbed, but rehabilitated areas and inoculate with salvaged lichen and biocrust material.
- Select some of these rehabilitated areas for monitoring the effect of topsoil application and inoculation on lichen and microphytic crust recovery.
- Include selected sites in environmental monitoring programme for the future mine.

❖ Minimise ground disturbance by stockpiling excavated material in disturbed areas inside service corridor and outside of more densely vegetated areas such as washes and drainage areas.
❖ Backfill excavated areas immediately upon laying of the pipeline.

The area of lichen fields to be destroyed is likely small and therefore suited to develop practical methods.

Construction planning needs to make allowance for lay-down, working and parking areas, as well as for other temporary facilities necessary for an increased work force. These areas should be limited as far as possible. Good demarcation will be essential to implement minimum disturbance measures.

During construction,

❖ House construction staff off-site
❖ Employ environmental staff during construction
❖ Strictly enforce park regulations/rules and environmental management guidelines
❖ Develop and implement Environmental Code of Conduct for employees and contractors.

4.2 Maintaining ecosystem function

► Linked to impact 1 and 5

The less natural areas are disturbed the greater the natural recovery potential of ecosystems. However, some disruption of the natural water flow can possibly not be avoided by the pipeline, as many washes cross the proposed route.

This is an ecological as well as an engineering challenge because severe floods could also cause a rupture of the pipeline if it is in the path of the water flow.

The engineers have suggested to bury the pipeline deeper in washes and drainage areas (± 1 m where possible) and supports will be constructed where necessary (W. Ewald, pers. comm. October 2021). This will likely solve this problem. Secondly the relatively small diameter of the pipeline (400 mm) will not create a 'dam' across the drainage area and natural water flow may be slightly diverted locally, but not blocked entirely.

Restoring lichen fields and biocrusts should be tested (as described above) to restore their soil stabilising and soil enrichment function.

4.3 Controlling invasive alien plants

► Linked to impact 4 and 6

Invasive alien plants such as *Argemone, Datura Nicotiana, Prosopis* and *Ricinus* could be introduced, if machinery that has been in contact with the Swakop River is used on site, or material (e.g. soil, rocks, etc.) from river environments is introduced. In such cases thorough cleaning of tyres and underbody is required before accessing the site. No material from alien-invested sites should be brought on site.

Alien invasive plants are pioneers and establish quickly where water is provided. This can be observed at many places along the two existing water pipelines.

Management measures:

- Clean underbody and tyres of machinery that was in contact with alien-infested areas.
- Bring no material from alien-infested sites on site
- Regularly check for leaks
- Monitor sites for invasive alien plants along pipeline and
- Eradicate immediately

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Annex 1. Impact assessment criteria

IMPACT ASSESSMENT CRITERIA		
SIGNIFICANCE determination	**Significance = consequence x probability**	
CONSEQUENCE	**Consequence is a function of:** • **Nature and Intensity of the potential impact** • **Geographical extent should the impact occur** • **Duration of the impact**	
Ranking the NATURE and INTENSITY of the potential impact		
Negative impacts		
Low (L)	The impact has no / minor effect/deterioration on natural, cultural and social functions and processes. No measurable change. Recommended standard / level will not be violated. (Limited nuisance related complaints).	
Moderate (M)	Natural, cultural and social functions and processes can continue, but in a modified way. Moderate discomfort that can be measured. Recommended standard / level will occasionally be violated. Various third party complaints expected.	
High (H)	Natural, cultural or social functions and processes are altered in such a way that they temporarily or permanently cease. Substantial deterioration of the impacted environment. Widespread third party complaints expected.	
Very high (VH)	Substantial deterioration (death, illness or injury). Recommended standard / level will often be violated. Vigorous action expected by third parties.	
Positive impacts		
Low (L) +	Slight positive effect on natural, cultural and social functions and processes Minor improvement. No measurable change.	
Moderate (M) +	Natural, cultural and social functions and processes continue but in a noticeably enhanced way. Moderate improvement. Little positive reaction from third parties.	
High (H) +	Natural, cultural or social functions and processes are altered in such a way that the impacted environment is considerably enhanced /improved. Widespread, noticeable positive reaction from third parties.	
Very high (VH) +	Substantial improvement. Will be within or better than the recommended level. Favourable publicity from third parties.	
Ranking the EXTENT		
Low (L)	Local (confined to within the project concession area and its nearby surroundings).	
Moderate (M)	Regional (confined to the region, e.g. coast, basin, catchment, municipal region, district, etc.).	
High (H)	National (extends beyond district or regional boundaries with national implications).	
Very high (VH)	International (Impact extends beyond the national scale or may be transboundary).	
Ranking the DURATION		
Low (L)	Temporary/short term. Quickly reversible. (Less than the life of the project).	
Moderate (M)	Medium Term. Impact can be reversed over time. (Life of the project).	
High (H)	Long Term. Impact will only cease after the life of the project..	
Very high (VH)	Permanent	
Ranking the PROBABILITY		
Low (L)	Unlikely	
Moderate (M)	Possibly	
High (H)	Most likely	
Very high (VH)	Definitely	
SIGNIFICANCE Description		
	Positive	**Negative**
Low (L)	Supports the implementation of the project	No influence on the decision.
Moderate (M)	Supports the implementation of the project	It should have an influence on the decision and the impact will not be avoided unless it is mitigated.
High (H)	Supports the implementation of the project	It should influence the decision to not proceed with the project or require significant modification(s) of the project design/location, etc. (where relevant).
Very high (VH)	Supports the implementation of the project	It would influence the decision to not proceed with the project.

DETERMINING THE CONSEQUENCE

DETERMINING THE CONSEQUENCE					
INTENSITY OF IMPACT = LOW					
DURATION	**VH**	**Moderate**	**Moderate**	**High**	**High**
	H	**Moderate**	**Moderate**	**Moderate**	**Moderate**

	M	Low	Low	Low	Moderate
	L	Low	Low	Low	Moderate
INTENSITY OF IMPACT = MODERATE					
DURATION	VH	Moderate	High	High	High
	H	Moderate	Moderate	High	High
	M	Moderate	Moderate	Moderate	Moderate
	L	Low	Moderate	Moderate	Moderate
INTENSITY OF IMPACT = HIGH					
DURATION	VH	High	High	Very High	Very high
	H	High	High	High	Very High
	M	Moderate	Moderate	High	High
	L	Moderate	Moderate	High	High
INTENSITY OF IMPACT = VERY HIGH					
DURATION	VH	Very high	Very High	Very High	Very high
	H	High	High	Very High	Very high
	M	High	High	High	Very High
	L	Moderate	High	High	Very High
		L	M	H	VH
		EXTENT			

DETERMINING THE SIGNIFICANCE

DETERMINING THE SIGNIFICANCE					
PROBABILITY	VH	Moderate	High	High	Very high
	H	Moderate	Moderate	High	Very high
	M	Low	Moderate	High	High
	L	Low	Low	Moderate	High
		L	M	H	VH
		CONSEQUENCE			

Annex 2. The environmental practitioner

Antje Burke

Academic qualifications

1993: **Dr rer nat** (Ph D), Major: **Landscape Ecology**, Minors: Botany, Geography; Westfälische Wilhelms-Universität, Münster, Germany
1987: **Diplom** (M Sc equivalent), Major: **Geography**, Minors: Botany, Geology
1984: First degree (B Sc equivalent): Geography, Botany, Geology

Dr Burke has over 30 years of professional experience in environmental research and management in Namibia, Germany, Israel, South Africa and Botswana. She has coordinated and participated in over 50 Environmental Impact Assessments, Management Plans, Audits, Sectoral Reviews and Natural Resource Assessments in Namibia – the majority in the mining and infrastructure sector. She is author of over 70 scientific publications, 50 of these in peer-reviewed, international journals and books, and over 100 popular and educational publications and is a scientific reviewer for eleven international journals. Dr Burke is a scientist widely recognised in her field of expertise. Her strong research background in environmental sciences, combined with in-depth practical experience, has enabled her to always maintain an exceptionally high standard, but unique and realistic approach in all her assignments.

Annex 3. Plant species recorded along the pipeline corridor.

This plant species list only shows what was recorded during the dry season survey in October 2021. Data from the National Botanical Research Institute's specimens database were reviewed but since these are recorded in an approximately 25x25 km grid pattern, they were found too broad to be included. More species are expected to emerge after adequate rains, even in the disturbed service corridor.

Species names follow Klaassen & Kwembeya 2013; p(F) = protected under Forest Act.

Plant species	Distribution and conservation status
*Arthraerua leubnitziae (*Kuntze) Schinz	Namib endemic
*Brownanthus kuntzei (*Schinz) Ihlenf.	Namib endemic
Citrullus eccirrhosus Cogn.	Namib endemic
Enneapogon cenchroides (Roem.& Schult.) C.E.Hubb.	
Galenia africana L.	
Galenia papulosa (Eckl. & Zeyh.) Sond.	
*Gomphocarpus filiformis (*E.Mey.) D.Dietr.	
Mesembryanthemum guerichianum Pax	
Nicotiana glauca Graham	introduced
*Phragmites australis (*Cav.) Steud.	
Prosopis glandulosa Torr. var. *glandulosa*	introduced
Senecio engleranus O.Hoffm.	Namib endemic
*Sesuvium sesuvioides (*Fenzl) I.Verd.	
Sonchus oleraceus L.	introduced
*Stipagrostis ciliata (*Desf.) De Winter var*. capensis* (Trin.& Rupr.) De Winter	
Tamarix ramosissima Ledeb.	introduced
Tamarix usneoides E. Mey. ex Bunge	p(F)
Tetragonia reduplicata Welw. ex Oliv.	
Zygophyllum simplex L.	
[3]*Zygophyllum stapffii* Schinz	

[3] There is some debate regarding the status of the genus *Zygophyllum*, which according to some taxonomists is now called *Tetraena*.

Appendix G: Fauna Specialist Study

VERTEBRATE FAUNA ASSOCIATED WITH THE BANNERMAN WATER SUPPLY PIPELINE, SWAKOPMUND AREA [Scoping/Literature Study]

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Expertise and Declaration of Independence

Peter Cunningham t.a. Environment and Wildlife Consultancy, Namibia (EWC Namibia) with registration number D/2021/0071, has prepared this vertebrate fauna section of the EIA on behalf of the proponent (ASEC CC). EWC, Namibia assists as local ecologist/specialist for a variety of environmental projects, mainly in Southern Africa and the Arabian Peninsula and is independent of the proponent and has no vested or financial interest in the proposed project, except for fair renumeration for professional services rendered.

EXECUTIVE SUMMARY

The proposed Bannerman Water Supply Pipeline development project is a 400mm diameter pipeline T/Off from the proposed Reptile Uranium Pipeline between the Swakopmund Base Pump Station and the C28 T/Off of approximately 60km in length and will follow the existing water pipeline corridor and branch off to the northeast to a Terminal Reservoir.

The general Swakopmund area is regarded as “low” in overall (all terrestrial species) diversity while the overall terrestrial endemism on the other hand is “moderate to high”. An estimated (i.e. at least) 54 reptile, 5 amphibian, 49 mammal and 130 bird species (breeding residents) are known/expected to occur in the general project area of which a high proportion are endemics (e.g. 53.7% for reptiles).

The most sensitive areas to avoid as far as possible (See Section 6.3 and Figure 2) would be:

1) Ephemeral drainage lines;
2) Marble/Granite ridges/rocky outcrops/inselbergs (i.e. light coloured “white and grey” geology); and
3) Lappet-faced vulture nesting sites (should these occur).

Planning of the pipeline route, especially the T/Off north-eastwards to the Terminal Reservoir, should take cognisance of the above sensitive habitats/areas/features and attempt not to disrupt wildlife corridors (e.g. foraging areas, especially vegetated drainage lines) and the overall interconnectivity of various habitats.

The pipeline from the T/Off north-eastwards to the Terminal Reservoir be placed below ground (dependent on geology) so as not to act as a barrier for ungulates/ostrich or if above ground due to terrain restrictions, then with ungulate/ostrich crossing points at drainage lines (i.e. below ground sections favoured at these sites).

The pipeline should follow a similar corridor to the existing pipelines to minimise the cumulative effect and overall impact on the environment.

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Acronyms, abbreviations and units

CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EIA	Environmental Impact Assessment
IUCN	International Union for the Conservation of Nature and Natural Resources
MEFT:	DNPW Ministry of Environment, Forestry and Tourism: Directorate of National Parks and Wildlife
NNP	Namib Naukluft Park
RT&E	Rare, Threatened and Endangered Species
SARDB	South African Red Data Book
Spp.	Species
ToR	Terms of Reference

1 Introduction

A literature study was conducted between 16 and 19 October 2021 to determine the vertebrate fauna (e.g. reptiles, amphibians, mammals and birds) known/expected to occur along the proposed Bannerman Water Supply Pipeline development – i.e. 400mm diameter pipeline T/Off from the proposed Reptile Uranium Pipeline between the Base Pump Station and the C28 T/Off – in the Swakopmund area (Figure 1). This survey was preceded by a review of the historical reports of the vertebrate fauna known/expected to occur in the general Swakopmund area (i.e. extending inland east of Swakopmund and roughly between Arandis, Gobabeb and Swakopmund) conducted by various authors (See Cunningham 2006, 2007, 2010, 2011, 2013, 2019, 2020, Griffin 2005a, Henschel *et al.* 2000, Henschel *et al.* 2011, Kavari 2007).

The general Swakopmund area is regarded as "low" in overall (all terrestrial species) diversity while the overall terrestrial endemism on the other hand is "moderate to high" (Mendelsohn *et al.* 2002). According to the literature survey an estimated (i.e. at least) 54 reptile, 5 amphibian, 49 mammal and 130 bird species (breeding residents) are known/expected to occur in the Tumas project area of which a high proportion are endemics (e.g. 53.7% for reptiles).

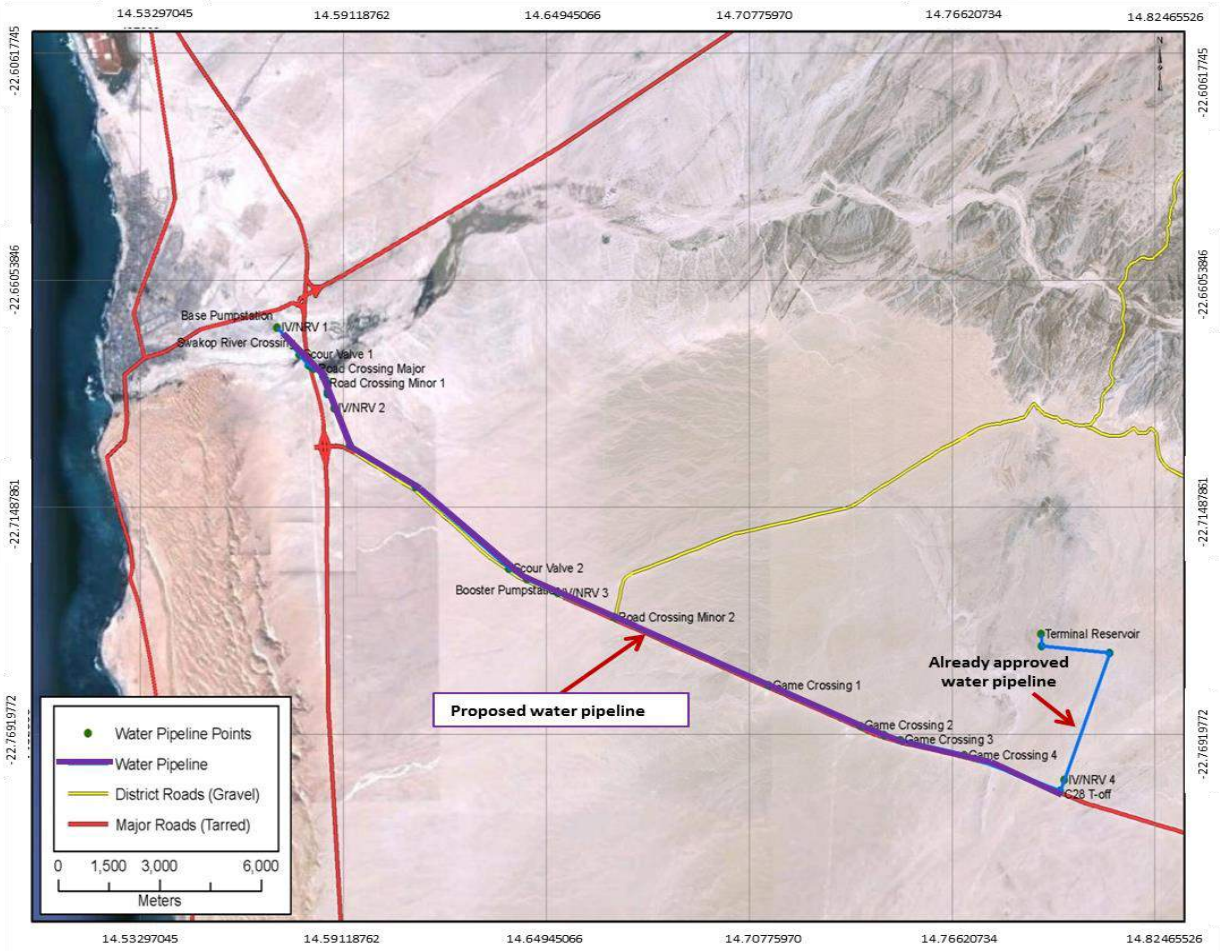

Figure 1. The proposed Bannerman Water Supply Pipeline development (blue line) southeast of Swakopmund (Source: Bannerman).

2. Terms of Reference (ToR)

1. Assess the bio-physical (vertebrate fauna) issues relevant to the above mentioned area.

2. Assess the significance of development and environmental impact that such developments may have on the vertebrate fauna at the proposed development site(s) including general comments.
3. Assess the impact of constructing a new 400mm pipeline T/Off towards the north of the existing pipeline between Swakopmund and Husab/Langer Heinrich. This T/Off is planned in conjunction with the proposed Reptile Uranium pipeline project – i.e. use the same pipeline.
4. Propose practical mitigation measures.

[Vertebrate fauna are classified as amphibians, birds, mammals & reptiles for this study]

3 Approach and Methodology

3.1 Assumptions, Limitations and Information Gaps

It is assumed that:

- all the relevant documents/maps have been supplied;
- all the proposed development activities have been indicated;
- all the areas to be developed have been indicated; and
- no additional developments planned consequently to this study being undertaken.

Limitations:

- The overall project area is large and although the focus of the literature study was in the proposed development area – i.e. along the pipeline route – it cannot be assumed that all species potentially present in the area were accounted for. This could mean that species – especially cryptic and lesser known species – such as burrowing reptiles, rodents and bats, may be excluded. However, this is unlikely with rather more species indicated as potentially occurring in the general area due to the greater extent of the literature study conducted;
- Species, especially reptiles, are constantly being revised taxonomically and although the latest nomenclature was followed, species may split or merge as subspecies or full species and/or have name changes as the project progresses; and
- No quantification for vertebrate fauna is available or possible to determine within the scope of this project.

3.2 I&AP Issues and Concerns

No biodiversity related I&AP comments/questions/issues are included.

3.3 Impact Assessment Methodology

The following Impact Assessment Criteria, Determining of Consequence and Significance are used:

Impact Assessment Criteria

IMPACT assessment criteria	
SIGNIFICANCE determination	**Significance = consequence x probability**
CONSEQUENCE	**Consequence is a function of:** • **Nature and Intensity of the potential impact** • **Geographical extent should the impact occur** • **Duration of the impact**
Ranking the NATURE and INTENSITY of the potential impact	
Negative impacts	
Low (L)	The impact has no / minor effect/deterioration on natural, cultural and social functions and

	processes. No measurable change. Recommended standard / level will not be violated. (Limited nuisance related complaints).
Moderate (M)	Natural, cultural and social functions and processes can continue, but in a modified way. Moderate discomfort that can be measured. Recommended standard / level will occasionally be violated. Various third party complaints expected.
High (H)	Natural, cultural or social functions and processes are altered in such a way that they temporarily or permanently cease. Substantial deterioration of the impacted environment. Widespread third party complaints expected.
Very high (VH)	Substantial deterioration (death, illness or injury). Recommended standard / level will often be violated. Vigorous action expected by third parties.
Positive impacts	
Low (L) +	Slight positive effect on natural, cultural and social functions and processes Minor improvement. No measurable change.
Moderate (M) +	Natural, cultural and social functions and processes continue but in a noticeably enhanced way. Moderate improvement. Little positive reaction from third parties.
High (H) +	Natural, cultural or social functions and processes are altered in such a way that the impacted environment is considerably enhanced /improved. Widespread, noticeable positive reaction from third parties.
Very high (VH) +	Substantial improvement. Will be within or better than the recommended level. Favourable publicity from third parties.
Ranking the EXTENT	
Low (L)	Local (confined to within the project concession area and its nearby surroundings).
Moderate (M)	Regional (confined to the region, e.g. coast, basin, catchment, municipal region, district, etc.).
High (H)	National (extends beyond district or regional boundaries with national implications).
Very high (VH)	International (Impact extends beyond the national scale or may be transboundary).
Ranking the DURATION	
Low (L)	Temporary/short term. Quickly reversible. (Less than the life of the project).
Moderate (M)	Medium Term. Impact can be reversed over time. (Life of the project).
High (H)	Long Term. Impact will only cease after the life of the project.
Very high (VH)	Permanent
Ranking the PROBABILITY	
Low (L)	Unlikely
Moderate (M)	Possibly
High (H)	Most likely
Very high (VH)	Definitely

SIGNIFICANCEDescription		
	Positive	**Negative**
Low (L)	Supports the implementation of the project	No influence on the decision.
Moderate (M)	Supports the implementation of the project	It should have an influence on the decision and the impact will not be avoided unless it is mitigated.
High (H)	Supports the implementation of the project	It should influence the decision to not proceed with the project or require significant modification(s) of the project design/location, etc. (where relevant).
Very high (VH)	Supports the implementation of the project	It would influence the decision to not proceed with the project.

Determining the consequence

DETERMINING THE CONSEQUENCE					
INTENSITY OF IMPACT = LOW					
DURATION	**VH**	**Moderate**	**Moderate**	**High**	**High**
	H	**Moderate**	**Moderate**	**Moderate**	**Moderate**
	M	**Low**	**Low**	**Low**	**Moderate**
	L	**Low**	**Low**	**Low**	**Moderate**
INTENSITY OF IMPACT = MODERATE					
DURATION	**VH**	**Moderate**	**High**	**High**	**High**
	H	**Moderate**	**Moderate**	**High**	**High**
	M	**Moderate**	**Moderate**	**Moderate**	**Moderate**
	L	**Low**	**Moderate**	**Moderate**	**Moderate**
INTENSITY OF IMPACT = HIGH					
DURATION	**VH**	**High**	**High**	**Very High**	**Very high**
	H	**High**	**High**	**High**	**Very High**
	M	**Moderate**	**Moderate**	**High**	**High**
	L	**Moderate**	**Moderate**	**High**	**High**
INTENSITY OF IMPACT = VERY HIGH					
DURATION	**VH**	**Very high**	**Very High**	**Very High**	**Very high**
	H	**High**	**High**	**Very High**	**Very high**
	M	**High**	**High**	**High**	**Very High**
	L	**Moderate**	**High**	**High**	**Very High**

	L	M	H	VH
EXTENT				

Determinin the significance

DETERMINING THE SIGNIFICANCE					
PROBABILITY	VH	Moderate	High	High	Very high
	H	Moderate	Moderate	High	Very high
	M	Low	Moderate	High	High
	L	Low	Low	Moderate	High
		L	M	H	VH
		CONSEQUENCE			

3.4 Field survey

No field survey conducted – i.e. literature study only. However, previous studies by the author were conducted along the entire pipeline route and adjasent areas (See: Cunningham 2010, 2013, Cunningham *et al.* 2015).

4 Legislative Context

Various Namibian laws are applicable to the proposed project:

- Soil Conservation Act 76 of 1969 (as amended in SA to March 1978)

The purpose of this Act is "*to consolidate and amend the law relating to the combating and prevention of soil erosion, the conservation, improvement and manner of use of the soil and vegetation and the protection of the water sources in the Republic and the territory of South-West Africa; and to provide for matters incidental thereto*."

- Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995)

The purpose of the Policy is seen as: informing decision makers and promoting accountability; ensuring that options and alternatives and environmental costs and benefits are considered; striving for a high degree of public participation and involvement of all sectors; incorporating internationally accepted norms and standards; taking into account secondary and cumulative environmental impacts; promoting the user pays principle; and promoting sustainable development. The Policy requires that all listed policies, programmes and projects, whether initiated by Government or the private sector, be subject to an Environmental Impact Assessment (EIA). Policies, programmes and projects requiring an Environmental Assessment (EA), amongst others, include: structure plans (e.g. land-use plans and policies); rezoning applications; establishment of settlements; power generation facilities with an output of 1 megawatt or more; electrical substations and transmission lines having equipment with an operating voltage in excess of 30 000 volts rms phase-to-phase; afforestation projects; major roads; major pipelines; major canals, aqueducts, river diversions and water transfers; permanent flood control schemes; small scale (formal) water supply schemes; deforestation projects; effluent plants; multinational projects; waste disposal sites; alternate energy programmes; and commercial tourism and recreation facilities (see Appendix B of the Policy).

- Nature Conservation Ordinance (No. 4 of 1975) – Nature Conservation Amendment Act (5 of 1996)

The Nature Conservation Amendment Act 5 of 1996 amends the Nature Conservation Ordinance, 1975, "so as to provide for an economically based system of sustainable management and utilization of game in communal areas; to delete references to representative authorities; and to provide for matters incidental hereto." Section 73. 1) provides: "No person other than the lawful holder of a permit granted by the local authority

shall at any time pick ("pick", as defined in Section 1 (xxxviii), includes to cut off, chop off, pick off, take, gather, uproot, damage or destroy) or transport any protected plant: Provided that – (a) the owner a nursery licensed under section 75 may without such permit pick and transport any protected plant cultivated on the premises of such nursery and cause such protected plant to be picked and transported; (b) the owner or lessee of land may on that land without such permit pick the flower of a protected plant for use as a decoration in his home; (c) the owner or lessee of land may without such permit pick a protected plant on that portion of such land – (i) which he needs for cultivated lands, the erection of a building, the construction of a road or airfield or any other development which necessitates the removal of vegetation; or (ii) on which such protected plant has been specially cultivated" (Nature Conservation Ordinance 4 of 1975, Chapter VI INDIGENOUS PLANTS, Picking and transport of protected plants).

- *Forest Act (No. 12 of 2001)*

The Act "provide for the establishment of a Forestry Council and the appointment of certain officials; to consolidate the laws relating to the management and use of forests and forest produce; to provide for the protection of the environment and the control and management of forest fires; to repeal the Preservation of Bees and Honey Proclamation, 1923 (Proclamation No.1 of 1923), Preservation of Trees and Forests Ordinance, 1952 (Ordinance No. 37 of 1952) and the Forest Act, 1968 (Act No. 72 of 1968); and to deal with incidental matters." Section 22. (1) provides: "Unless otherwise authorised by this Act, or by a licence issued under subsection (3), no person shall on any land which is not part of a surveyed erven of a local authority area as defined in section 1 of the Local Authorities Act, 1992 (Act No. 23 of 1992) cut, destroy or remove - (a) vegetation which is on a sand dune or drifting sand or on a gully unless the cutting, destruction or removal is done for the purpose of stabilising the sand or gully; or (b) any living tree, bush or shrub growing within 100 metres of a river, stream or watercourse."

- Environmental Management Act (No. 7 of 2007)

The Environmental Management Act (EMA) gives legislative effect to the Environmental Assessment Policy. The purpose of EMA is to "promote the sustainable management of the environment and the use of natural resources by establishing principles for decision making on matters affecting the environment; to establish the Sustainable Development Advisory Council; to provide for the appointment of the Environmental Commissioner and environmental officers; to provide for a process of assessment and control of activities which may have significant effects on the environment; and to provide for incidental matters." Even though EMA has been promulgated, but not yet implemented, the twelve principles of environmental management (Part II, Section 3 of the Act) should be applied to all projects that may impact on the environment: i) use renewable resources on a sustainable basis for the benefit of present and future generations; ii) involve the community in natural resources management and promote and facilitate the sharing of benefits from the use of resources; iii) promote public participation in decisions affecting the environment and ensure that their interests, needs and values are taken into account; iv) promote equitable access to all environmental resources and consider the functional integrity of ecological systems so that the sustainability of systems is ensured and that harmful effects are prevented; v) undertake environmental assessments for all projects that may adversely impact on the environment, or the use of natural resources; vi) promote sustainable development in all aspects relating to the environment; vii) protect and respect Namibia's cultural and natural heritage, including its biological diversity, for the benefit of present and future generations; viii) reduce the generation of waste and polluting substances at source by adopting the option that provides the most benefit or causes the least environmental damage, at costs acceptable by society, in the short and long term; ix) promote the reduction, re-use and recycling of waste; x) adopt the "polluter pays principle"; xi) in cases where there is sufficient evidence to conclude that there are threats of serious or irreversible damage to the environment, the lack of full scientific certainty may not be used as an excuse for postponing cost-effective measures to

prevent environmental degradation; and xii) prevent damage to the environment; if this is not possible, reduce, limit, or control activities that may cause damage (to the environment).

- Namibia's Second National Biodiversity Strategy and Action Plan (2013-2022)

Namibia's NBSAP2 covers the period 2013-2022, and its vision is for "Namibia's biodiversity to be healthy and resilient to threats, and for the conservation and sustainable use of biodiversity to be key drivers of poverty alleviation and equitable economic growth, particularly in rural areas." The Strategic Goals and Targets of NBSAP2 are:

i. *Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society;*
ii. *Reduce direct pressures on biodiversity and promote the sustainable use of biological resources;*
iii. *Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity;*
iv. *Enhance the benefits to all from biodiversity and ecosystem services; and*
v. *Enhance implementation of NBSAP2 through participatory planning, knowledge management and capacity building.*

Various international legally binding agreements are applicable to the proposed project:

- Convention on Biological Diversity

The Convention on Biological Diversity (CBD) was signed by 150 government leaders at the 1992 Rio Earth Summit and entered into force in December 1993. There are currently 188 Parties to the Agreement. The three objectives of the Convention are: the conservation of biodiversity, the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. The principles of the CDB are broad in scope and unlike CITES, the CBD does not contain detailed provisions on implementation. Accordingly, implementation of the CBD depends on the incorporation of the Convention and associated policies and guidelines into the national legislation of Member States. The CBD was signed by Namibia on 12 June 1992 in Rio de Janeiro and ratified it on 18 March 1997. Accordingly Namibia is obliged to ensure that its domestic legislation conforms to the objectives and obligations of the CBD. Namibia gives effect to the CBD inter alia by implementing the National Biodiversity Strategy and Action Plan and has issued its sixth national report under the CBD for the period 2014-2018. Also of relevance are the Nagoya Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization to the convention on biological diversity which Namibia has acceded to.

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)

The aim of CITES is to protect certain endangered species from over-exploitation by means of a system of import-export permits. The CITES Convention includes animals and plants whether dead or alive, and any recognizable parts of derivatives thereof. Appendix I to the Convention covers endangered species, trade in which is to be tightly controlled; Appendix II covers species that may become endangered unless trade is regulated; Appendix III covers species that any party wishes to regulate and requires international cooperation to control trade; and Appendix IV contains model permits. Permits are required for species listed in Appendices I and II stating that export / import will not be detrimental to the survival of the species. The CITES Secretariat is administered by UNEP and is located at Geneva, Switzerland. Namibia joined in 1990 through accession which came into force in 1991. MET is the agency responsible for implementation of CITES.

- *The African Convention on the Conservation of Nature and Natural Resources (revised) 2003:*

Participating and signatory states undertake to adopt the measures necessary to ensure conservation, utilisation and development of soil, water, floral and faunal resources in accordance with scientific principles and with due regard to the best interests of the people (Article II); to take effective measures to conserve and improve the soil and to control erosion and land use (Article IV); and to establish policies to conserve, utilise and develop water resources, prevent pollution and control water use (Article V). Furthermore, the Convention imposes on states the obligation to protect flora and ensure its best utilisation, the management of forests and control of burning, land clearance and overgrazing (Article VI); and to conserve faunal resources and use them wisely, manage populations and habitats, control hunting, capture and fishing, and prohibit the use of poisons, explosives and automatic weapons in hunting (Article VII). States are required to tightly control traffic in trophies, to prevent trade in illegally killed and obtained trophies and to establish and maintain conservation areas (Article X). A list of protected species which enjoy full total protection, and a list of species, which may be taken only with authorisation is part of the Convention. Namibia signed the agreement in 2003.

- *SADC Protocol on Forestry, 2002 (entered into force within SADC on 1 September 2006)*

This Protocol applies to all activities related to development, conservation, sustainable management and utilisation of all types of forests and trees, as well as trade in forest products. Article 4.1 provides the guiding principles to which state parties must cooperate in good faith. The protocol further provides for the tenure and ownership of state-owned forests, national forest policies and programmes for the introduction and implementation of national legal and administrative measures to promote sustainable forest management. Namibia signed the agreement in 2002.

- *SADC Protocol on Wildlife Conservation and Law Enforcement, 1999*

This Protocol aims to establish within the framework of the respective national laws of each State Party, common approaches to the conservation and sustainable use of wildlife resources and to assist with the effective enforcement of laws governing those resources. Each State Party has to ensure the conservation and sustainable use of wildlife resources under its jurisdiction, and that activities within its jurisdiction or control do not cause damage to the wildlife resources of other states or in areas beyond the limits of national jurisdiction. In line with Article 4 of the Protocol, appropriate policy, administrative and legal measures have to be taken to ensure the conservation and sustainable use of wildlife and to enforce national legislation pertaining to wildlife effectively. Namibia signed the agreement in 1999.

- *United Nations Sustainable Development Goals (SDGs) 2015*

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognise that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests. Of specific relevance to ecology is SDG 15: Life on Land which aims to "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss".

5 Project Description

The proposed project is a 400mm diameter pipeline T/Off from the proposed Reptile Uranium Pipeline between the Swakopmund Base Pump Station and the C28 T/Off of approximately

60km in length and will follow the existing water pipeline corridor and branch off to the north to a Terminal Reservoir (See Figure 1).

[This is a brief description of the project and a comprehensive project description will be presented in the final EIA report]

6. Description of the Receiving Environment

6.1 Vertebrate Fauna

6.1.1 Reptile Diversity

Reptile diversity known and/or expected to occur in the general Bannerman Water Supply Pipeline Project area – literature study only – is presented in Table 1.

Approximately 261 species of reptiles are known or expected to occur in Namibia thus supporting approximately 30% of the continents species diversity (Griffin 1998a). At least 22% or 55 species of Namibian lizards are classified as endemic. The occurrence of reptiles of "conservation concern" includes about 67% of Namibian reptiles (Griffin 1998a). Emergency grazing and large scale mineral extraction in critical habitats are some of the biggest problems facing reptiles in Namibia (Griffin 1998a). The overall reptile diversity and endemism in the general area is estimated at between 41-50 species and 21-24 species, respectively (Mendelsohn *et al.* 2002). Griffin (1998a) presents figures of between 21-30 and 7-8 for endemic lizards and snakes, respectively, from the general area.

At least 54 species of reptiles are expected to occur in the general area with 29 species being endemic – i.e. 53.7% endemic. Two species expected to occur in the area (*Stigmochelys pardalis* and *Varanus albigularis*) are classified as vulnerable and protected game although both, especially *S. pardalis*, probably only occasionally passes through the general area as a vagrant and not expected to occur permanently in the area due to the overall arid conditions. *Pelomedusa subrufa* is only expected to occur in drainage lines in the area (e.g. Khan, Kuiseb, Swakop and Tumas Rivers and their tributaries) with suitable habitat – i.e. long lasting water holes. *Lycophidion capense* and *Lycophidion namibianum* only marginally occur in the Namib-Naukluft Park (Griffin 1998a) and potentially could occur in the general area. Two important species not included in Table 1 due to both being sand/dune dwelling species, although potentially could occur in the area dependent on suitable habitat, are *Bitis peringueyi* (Péringuey's Adder) and *Pachydactylus rangei* (Web-footed gecko).

Afroedura africana africana is classified as insufficiently known and rare (Griffin 2003) and probably the reptile of most concern in the general area. Another important species from the general area is *Pedioplanis husabensis* which although secure (Griffin 2003) is associated with the Husab Mountains and surrounding area only (Cunningham *et al.* 2012). Nine species have an international conservation status (i.e. IUCN; SARDB and CITES) with *Varanus albigularis* the species of most concern and classified as vulnerable, peripheral and protected game under Namibian legislation and listed as safe to vulnerable by the SARDB (2004). The IUCN (2021) classifies 4 species as least concern although few reptiles have been assessed for the IUCN Red List.

The 54 species expected to occur in the general area consist of at least 18 snakes (2 thread snakes, 1 quill snouted and 15 typical snakes) of which 8 species (44.4%) are endemic, 1 tortoises, 1 terrapin, 14 lizards of which 6 species classified as endemic (42.9% endemic), 1 plated lizards, 1 monitor, 1 agama, 1 chameleon and 15 geckos of which 13 species classified as endemic (i.e. 86.7% endemic).

Gecko's (15 species with 13 species being endemic) and snakes (18 species with 8 species being endemic) are the most important groups of reptiles expected from the general area followed by lizards (14 species with 6 species being endemic). Namibia with approximately 129 species of lizards (Lacertilia) has one of the continents richest lizard fauna (Griffin 1998a). Geckos expected and/or known to occur in the general area have the highest occurrence of endemics (86.7%) of all the reptiles in this area. Griffin (1998a) confirms the importance of the gecko fauna in Namibia.

Table 1. Reptile diversity expected to occur in the general Bannerman Water Supply Pipeline Project area – literature study.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
TURTLES AND TERRAPINS					
Stigmochelys pardalis	Leopard Tortoise	Vulnerable; Peripheral; Protected Game			C2
Pelomedusa subrufa	Marsh/Helmeted Terrapin	Secure			C3
SNAKES					
Thread Snakes					
Namibiana (Leptotyphlops) occidentalis	Western Thread Snake	Endemic; Secure	P		
Namibiana (Leptotyphlops) labialis	Damara Thread Snake	Endemic; Secure			
Quill Snouted Snakes					
Xenocalamus bicolour bicolor	Bicoloured Quill-snouted Snake	Secure			
Typical Snakes					
Lamprophis fuliginosus	Brown House Snake	Secure			
Lycophidion capense	Cape Wolf Snake	Secure			
Lycophidion namibianum	Namibian Wolf Snake	Endemic; Secure			
Pseudaspis cana	Mole Snake	Secure			
Pythonodipsas carinata	Western Keeled Snake	Endemic; Secure			
Dipsina multimaculata	Dwarf Beaked Snake	Endemic; Secure			
Psammophis trigrammus	Western Sand Snake	Endemic; Secure			
Psammophis notostictus	Karoo Sand Snake	Secure			
Psammophis leightoni namibensis	Namib Sand Snake	Secure			
Dasypeltis scabra	Common/Rhombic Egg Eater	Secure			
Aspidelaps lubricus infuscatus	Coral Snake	Secure			
Aspidelaps scutatus	Shield-nose Snake	Endemic; Secure			
Naya nigricincta	Black-necked Spitting Cobra	Endemic; Secure	R		
Bitis arietans	Puff Adder	Secure			
Bitis caudalis	Horned Adder	Secure			
LIZARDS					
Skinks					
Typhlacontias brevipes	FitzSimon's Burrowing Skink	Endemic; Secure			
Trachylepis acutilabris	Wedge-snouted Skink	Secure			
Trachylepis occidentalis	Western Three-striped Skink	Secure			
Trachylepis striata wahlbergi	Striped Skink	Secure			
Trachylepis sulcata	Western Rock Skink	Secure			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
Trachylepis variegata variegata	Variegated Skink	Secure			
Old World Lizards					
Heliobolus lugubris	Bushveld Lizard	Secure			
Meroles anchietae	Shovel-snouted Lizard	Secure			
Meroles reticulatus	Reticulated Desert Lizard	Endemic; Secure			
Meroles suborbitalis	Spotted Desert Lizard	Endemic; Secure			
Pedioplanis breviceps	Short-headed Sand Lizard	Endemic; Secure			
Pedioplanis namaquensis	Namaqua Sand Lizard	Secure			
Pedioplanis inornata	Plain Sand Lizard	Endemic; Secure			
Pedioplanis husabensis	Husab Sand Lizard	Endemic; Secure			
Plated Lizards					
Cordylosaurus subtessellatus	Dwarf Plated Lizard	Endemic; Secure		LC	
Monitors					
Varanus albigularis	Rock or White-throated Monitor	Vulnerable; Peripheral; Protected Game	S to V		C2
Agama					
Agama planiceps	Namibian Rock Agama	Endemic; Secure			
Chameleons					
Chamaeleo namaquensis	Namaqua Chameleon	Secure		LC	C2
Geckos					
Afroedura africana africana	African Flat Gecko	Endemic; Insufficiently known; Rare?			
Chondrodactylus angulifer namibensis	Giant Ground Gecko	Endemic; Secure			
Narudasia festiva	Festive Gecko	Endemic; Secure			
Pachydactylus bicolor	Velvety Thick-toed Gecko	Endemic; Secure			
Pachydactylus kochii	Kock's Thick-toed Gecko	Endemic; Secure			
Pachydactylus turneri	Turner's Thick-toed Gecko	Secure			
Pachydactylus punctatus	Speckled Thick-toed Gecko	Secure			
Pachydactylus rugosus rugosus	Rough Thick-toed Gecko	Endemic; Secure			
Pachydactylus weberi werneri	Weber's Thick-toed Gecko	Endemic; Secure		LC	
Ptenopus carpi	Carp's Barking Gecko	Endemic; Secure			
Ptenopus garrulus maculatus	Common Barking Gecko	Endemic; Secure			
Ptenopus kochi	Koch's Barking Gecko	Endemic; Secure		LC	
Phelsuma (Rhoptropus) afer	Common Namib Day Gecko	Endemic; Secure			
Phelsuma (Rhoptropus) boultoni	Boulton's Namib Day Gecko	Endemic; Secure			
Phelsuma (Rhoptropus) bradfieldi	Bradfield's Namib Day Gecko	Endemic; Secure			

Namibian conservation and legal status according to the Nature Conservation Ordinance No 4 of 1975 (Griffin 2003)
Endemic – includes Southern African Status (Branch 1998)
SARDB (2004): S to V – Safe to Vulnerable; V – Vulnerable; P – Peripheral
IUCN (2021): LC – Least Concern [All other species not yet assessed]
CITES: CITES Appendix 2/3 species
Source for literature review: Alexander and Marais (2007), Branch (1998), Branch (2008), Bonin *et al.* (2006), Boycott and Bourquin (2000), Broadley (1983), Buys and Buys (1983), Cunningham (2013), Cunningham (2020), Griffin (2003), Hebbard (n.d.), IUCN (2021), Marais (1992), SARDB (2004), Tolley and Burger (2007)

The endemic *Afroedura africana africana* (African flat gecko) and *Pedioplanis husabensis* (Husab sand lizard) are viewed as the most important reptiles potentially occurring in the area. *Pedioplanis husabensis* is very habitat specific and mainly occurs on "white/grey" geology in the Khan River area south of Arandis (Cunningham *et al.* 2012). *Leptotyphlops occidentalis* (western thread snake) and *Lycophidion namibianum* (Namibian wolf snake) are the snakes viewed as the most important in the area.

The most important species is the endemic *Pedioplanis husabensis* (Husab Sand Lizard) which is a restricted range species (100% of the taxon's range within Namibia) occurring in the general area of the confluence of the Swakop and Khan Rivers. It is furthermore viewed as "threatened" by the 'uranium rush' (SAIEA 2010) with its total known range currently estimated at <5,000km² (Wassenaar *et al.* 2010) which would put it in the "endangered" category according to the IUCN Red List Categories and Criteria (IUCN 2021). Cunningham *et al.* (2012) showed that *P. husabensis* is an extreme habitat specialist, selecting not only marble substrates, but specifically marble surrounded by other bare rock types.

As reptiles are generally understudied animals; occur at low densities in such marginal habitat, many more species are expected to occur in the general Bannerman Water Supply Pipeline Project area than confirmed during fieldwork in the neighbouring areas by Cunningham (2013, 2021). However, except for *Pedioplanis husabensis* associated with specific habitat and geology in the general area, no reptiles are exclusively associated with the Bannerman Water Supply Pipeline Project area.

Other areas:
As reptiles are viewed as an important group in the desert areas of Namibia the following unpublished reports are included from the general area:

Other reptile related work in the general area includes Henschel *et al.* (2000) from Gobabeb, Griffin (2005) from Valencia, Cunningham (2006) from Trekkopje, Cunningham (2007) from Valencia, Cunningham (2010) from INCA and TRS, Cunningham (2011) from Khan River, Henschel *et al.* (2011) from Marenica, Cunningham (2013) from Ongolo and Tumas, Kavari (2007) from Rössing Uranium Mine, Cunningham (2019) from the Kuiseb River Delta area and Cunningham (2020) from the Tumas area. Their findings are presented in the following tables:

According to Henschel *et al.* (2000) at least 20 species of lizards (12 geckos, 5 lizards and 3 skinks) have been recorded on the gravel plains at Gobabeb (Desert Research site approximately 90km southeast of the Bannerman Water Supply Pipeline Project area).

Table 2. Reptiles recorded on the gravel plains at Gobabeb.

Family and Scientific name	Common name
Gekkonidae	
Chondrodactylus angulifer	Giant Ground Gecko
Pachydactylus kockii	Koch's Thick-toed Gecko
Pachydactylus turneri	Turner's Thick-toed Gecko
Pachydactylus scherzi	Schertz's Thick-toed Gecko
Pachydactylus rugosus	Rough Thick-toed Gecko
Pachydactylus rangei	Palmato gecko
Ptenopus carpi	Banded Barking Gecko
Ptenopus garrulus	Common Barking Gecko
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus barnardi	Lesser Namib Day Gecko
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko
Narudasia festiva	Festive Gecko
Lacertidae	
Meroles suborbitalis	Spotted Desert Lizard

Family and Scientific name	Common name
Pedioplanis breviceps	Short-headed Sand Lizard
Pedioplanis lineoocellata	Ocellated Sand Lizard
Pedioplanis namaquensis	Namaqua Sand Lizard
Pedioplanis undata	Western Sand Lizard
Scincidae	
Trachylepis acutilabris	Wedge-snouted Skink
Trachylepis occidentalis	Western Three-striped Skink
Trachylepis spilogaster	Namibian Tree Skink

Source: Henschel *et al.* (2000)

Table 3 indicates the reptile diversity known, reported and/or expected to occur (77 species) in the general Valencia Uranium area (approximately 80km east of the general Bannerman Water Supply Pipeline Project area) as presented by Griffin (2005a).

Table 3. Reptiles reported and/or expected to occur in the general Valencia area.

Species: Scientific name	Common name
Turtles and Tortoises and Terrapins	
Geochelone pardalis	Leopard tortoise
Pelomedusa subrufa	Marsh/Helmeted Terrapin
Snakes	
Worm Snakes	
Leptotyphlops occidentalis	Western Thread/Worm Snake
Leptotyphlops labialis	Damara Thread/Worm Snake
Leptotyphlops scutifrons	Peter's Thread/Worm Snake
Blind Snakes	
Rhinotyphlops lalandei	Delalande's Blind Snake
Rhinotyphlops schinzi	Beaked Blind Snake
Boas and Pythons	
Python anchietae	Namibian Dwarf Python
Typical Snakes	
Lamprophis fuliginosus	Brown House Snake
Pseudaspis cana	Mole Snake
Psammophylax rhombeatus	Spotted Skaapsteker
Dipsina multimaculata	Dwarf Beaked Snake
Psammophis trigrammus	Western Sand Snake
Psammophis notostictus	Karoo Sand Snake
Psammophis leightoni namibensis	Namib Sand Snake
Psammophis subtaeniatus	Western Striped-bellied Sand Snake
Psammophis leopardinus	Leopard Whip Snake
Dasypeltis scabra	Common/Rhombic Egg Eater
Philothamnus semivariegatus	Spotted Bush Snake
Telescopus beetzii	Namaqua Tiger Snake
Telescopus semiannulatus	Southern Tiger Snake
Telescopus sp. nov.	Damara Tiger Snake
Pythonodipsas carinata	Western keeled Snake
Prosymna frontalis	Shouthwestern Shovel-snout
Aspidelaps lubricus infuscatus	Coral Snake
Aspidelaps scutatus scutatus	Shield-nose Snake
Naja anchietae	Angolan Cobra
Naja nigricollis nigricincta	Black-necked Spitting Cobra
Naja woodi	Black Spitting Cobra
Naja nivea	Cape Cobra
Dendroaspis polylepis	Black Mamba
Bitis arietans	Puff Adder
Bitis caudalis	Horned Adder
Lizards	

Species: Scientific name	Common name
Worm Lizards	
Zygaspis quadrifrons	Kalahari Round-headed Worm Lizard
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Trachylepis occidentalis	Western Three-striped Skink
Trachylepis hoeschi	Western Rock Skink
Trachylepis spilogaster	Namibian Tree Skink
Trachylepis sulcata	Western Rock Skink
Trachylepis variegata variegata	Variegated Skink
Trachylepis wahlbergii	Wahlberg's Striped Skink
Old World Lizards	
Nucras intertexta	Spotted Sandveld Lizard
Heliobolus lugubris	Bushveld Lizard
Meroles knoxii	Round-snouted Sand Lizard
Meroles cuneirostris	Wedge-snouted Desert Lizard
Meroles suborbitalis	Spotted Desert Lizard
Pedioplanis breviceps	Short-headed Sand Lizard
Pedioplanis lineoocellata	Ocellated Sand Lizard
Pedioplanis namaquensis	Namaqua Sand Lizard
Pedioplanis gaerdesi	Damara Sand Lizard
Pedioplanis undata	Western Sand Lizard
Pedioplanis inornata	Plain Sand Lizard
Pedioplanis hasabensis	Husab Sand Lizard
Plated Lizards	
Cordylosaurus subtessellatus	Dwarf Plated Lizard
Gerrhosaurus nigrolineatus	Black-lined Plated Lizard
Gerrhosaurus validus	Giant Plated Lizard
Monitors	
Varanus albigularis	Rock Monitor
Agamas	
Agama anchietae	Western Rock Agama
Agama planiceps	Namibian Rock Agama
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Afroedura africana africana	African Flat Gecko
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Narudasia festiva	Festive Gecko
Pachydactylus bicolour	Velvety Thick-toed Gecko
Pachydactylus capensis	Cape Thick-toed Gecko
Pachydactylus fasciatus	Damaraland Banded Thick-toed Gecko
Pachydactylus kockii	Koch's Thick-toed Gecko
Pachydactylus punctatus	Speckled Thick-toed Gecko
Pachydactylus turneri	Turner's Thick-toed Gecko
Pachydactylus scherzi	Schertz's Thick-toed Gecko
Pachydactylus rugosus rugosus	Rough Thick-toed Gecko
Pachydactylus weberi	Weber's Thick-toed Gecko
Lygodactylus bradfieldi	Namibian Dwarf Gecko
Ptenopus garrulus maculatus	Common Barking Gecko
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus barnardi	Lesser Namib Day Gecko
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko

Source: Griffin (2005)

A survey of the reptiles associated with the Trekkopje Uranium Mining area (approximately 60km northeast of the general Bannerman Water Supply Pipeline Project area) conducted by

Cunningham (2006b) indicated the presence of 22 reptile species (8 snakes, 1 skink, 2 lizards, 2 agamas, 1 chameleon and 8 geckos) (Table 4).

Table 4. Reptiles recorded in the general Trekkopje Uranium Mining area.

Species: Scientific name	Species: Common name
Typical Snakes	
Lamprophis fuliginosus	Brown House Snake
Lycophidion namibianum	Namibian Wolf Snake
Dipsina multimaculata	Dwarf Beaked Snake
Psammophis leightoni namibensis	Namib Sand Snake
Dasypeltis scabra	Common Egg Eater
Aspidelaps lubricus infuscatus	Coral Snake
Naya nigricincta	Black-necked Spitting Cobra
Bitis caudalis	Horned Adder
Lizards	
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Old World Lizards	
Pedioplanis namaquensis	Namaqua Sand Lizard
Pedioplanis husabensis	Husab Sand Lizard
Agamas	
Agama aculeata	Ground Agama
Agama anchietae	Anchieta's Agama
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Lygodactylus bradfieldi	Bradfield's Dwarf Gecko
Pachydactylus bicolor	Velvety Thick-toed Gecko
Pachydactylus serval serval	Western Spotted Thick-toed Gecko
Ptenopus carpi	Carp's Barking Gecko
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus boultoni	Boulton's Namib Day Gecko
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko

Source: Cunningham (2006b)

A survey of the reptiles associated with the Valencia Mine (approximately 90km northeast of the general Bannerman Water Supply Pipeline Project area) conducted by Cunningham (2007) indicated the presence of 14 reptile species (5 snakes, 2 skinks, 1 lizards, 1 agama, 1 chameleon and 4 geckos) (Table 5).

Table 5. Reptiles recorded in the general Valencia area.

Species: Scientific name	Species: Common name
Typical Snakes	
Lamprophis fuliginosus	Brown House Snake
Psammophis trigrammus	Western Sand Snake
Psammophis leightoni namibensis	Namib Sand Snake
Aspidelaps lubricus infuscatus	Coral Snake
Bitis caudalis	Horned Adder
Lizards	
Skinks	
Trachylepis hoeschi	Western Rock Skink
Trachylepis sulcata	Western Rock Skink
Old World Lizards	
Pedioplanis husabensis	Husab Sand Lizard
Agamas	
Agama anchietae	Anchieta's Agama

Species: Scientific name	Species: Common name
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Pachydactylus turneri	Turner's Thick-toed Gecko
Ptenopus garrulus maculatus	Common Barking Gecko
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko

Source: Cunningham (2007)

A survey of the reptiles associated with the INCA and TRS sites (approximately 20-30km east/southeast of the general Bannerman Water Supply Pipeline Project area) conducted by Cunningham (2010) indicated the presence of 14 reptiles species (3 snakes, 1 skink, 2 lizards, 1 chameleon and 7 geckos) (Table 6).

Table 6. Reptiles recorded in the general INCA and TRS areas.

Family and Scientific name	Common name
Typical Snakes	
Psammophis leightoni namibensis	Namib Sand Snake
Naya nigricincta	Black-necked Spitting Cobra
Bitis caudalis	Horned Adder
Lizards	
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Old World Lizards	
Meroles suborbitalis	Spotted Desert Lizard
Pedioplanis inornata	Plain Sand Lizard
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Pachydactylus bicolor	Velvety Thick-toed Gecko
Pachydactylus kochii	Kock's Thick-toed Gecko
Pachydactylus punctatus	Speckled Thick-toed Gecko
Ptenopus carpi	Carp's Barking Gecko
Ptenopus garrulus maculatus	Common Barking Gecko
Rhoptropus afer	Common Namib Day Gecko

Source: Cunningham (2010)

A survey of the reptiles associated with the Khan River area (approximately 70km east of the general Bannerman Water Supply Pipeline Project area) conducted by Cunningham (2011) indicated the presence of 6 reptile species (2 skinks, 1 lizard, 1 agama and 2 geckos) (Table 7).

Table 7. Reptiles recorded in the general Khan River area.

Species: Scientific name	Species: Common name
LIZARDS	
Skinks	
Trachylepis variegata variegata	Variegated Skink
Trachylepis hoeschi	Hoesch' Skink
Old World Lizards	
Meroles suborbitalis	Spotted Desert Lizard
Agama	
Agama planiceps	Namibian Rock Agama

Species: Scientific name	Species: Common name
Geckos	
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus boultoni	Boulton's Namib Day Gecko

Source: Cunningham (2011)

A survey of the reptiles associated with the Marenica Mining site in the Spitzkoppe area (approximately 110km northeast of the general Bannerman Water Supply Pipeline Project area) conducted by Henschel *et al.* (2011) indicated the presence of 19 reptiles species (1 snake, 5 skinks, 6 lizards, 2 agamas, 1 chameleon and 4 geckos) (Table 8).

Table 8. Reptiles recorded in the general Marenica (Spitzkoppe) area.

Family and Scientific name	Common name
Typical Snakes	
Psammophis leightoni namibensis	Namib Sand Snake
Lizards	
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Trachylepis occidentalis	Western Three-striped Skink
Trachylepis hoeschi	Western Rock Skink
Trachylepis spilogaster	Namibian Tree Skink
Trachylepis variegata variegata	Variegated Skink
Old World Lizards	
Pedioplanis breviceps	Short-headed Sand Lizard
Pedioplanis inornata	Plain Sand Lizard
Pedioplanis namaquensis	Namaqua Sand Lizard
Agamas	
Agama anchietae	Anchieta's Agama
Agama planiceps	Namibian Rock Agama
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Pachydactylus bicolor	Velvety Thick-toed Gecko
Pachydactylus turneri	Turner's Thick-toed Gecko
Pachydactylus scherzi	Schertz's Thick-toed Gecko
Ptenopus garrulus maculatus	Common Barking Gecko
Rhoptropus boultoni	Boulton's Namib Day Gecko
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko

Source: Henschel *et al.* (2011)

A survey of the reptiles associated with the Ongolo and Tumas sites (approximately 20-30km east/southeast of the general Bannerman Water Supply Pipeline Project area) conducted by Cunningham (2013) indicated the presence of 26 reptiles species (6 snakes, 3 skinks, 6 lizards, 1 monitor, 1 chameleon and 9 geckos) (Table 9).

Table 9. Reptiles recorded in the general Ongolo and Tumas areas.

Family and Scientific name	Common name
Typical Snakes	
Dipsina multimaculata	Dwarf Beaked Snake
Psammophis leightoni namibensis	Namib Sand Snake
Aspidelaps lubricus infuscatus	Coral Snake
Naya nigricincta	Black-necked Spitting Cobra
Bitis arietans	Puff Adder
Bitis caudalis	Horned Adder

LIZARDS	
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Trachylepis sulcata	Western Rock Skink
Trachylepis variegata variegata	Variegated Skink
Old World Lizards	
Meroles reticulatus	Reticulated Desert Lizard
Meroles suborbitalis	Spotted Desert Lizard
Pedioplanis breviceps	Short-headed Sand Lizard
Pedioplanis namaquensis	Namaqua Sand Lizard
Pedioplanis inornata	Plain Sand Lizard
Pedioplanis husabensis	Husab Sand Lizard
Monitors	
Varanus albigularis	Rock or White-throated Monitor
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Pachydactylus bicolor	Velvety Thick-toed Gecko
Pachydactylus kochii	Kock's Thick-toed Gecko
Pachydactylus turneri	Turner's Thick-toed Gecko
Pachydactylus punctatus	Speckled Thick-toed Gecko
Ptenopus carpi	Carp's Barking Gecko
Ptenopus garrulus maculatus	Common Barking Gecko
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus boultoni	Boulton's Namib Day Gecko

Source: Cunningham (2013)

A pilot study conducted by Kavari (2007) on the reptile diversity associated with the future expansion of the Rössing Uranium Mine (approximately 30-40km northeast of the general Bannerman Water Supply Pipeline Project area) indicated the presence of 6 reptile species (3 geckos, 1 lizard, 1 chameleon and 1 snake) (Table 10).

Table 10. Reptiles recorded in the general Rössing Uranium Mine area.

Family and Scientific name	Common name
Typical snakes	
Psammophis notostictus	Karoo Sand Snake
Geckkonidae	
Trachylepis variegata variegata	Variegated Skink
Trachylepis hoeschi	Western Rock Skink
Ptenopus garrulus	Common Barking Gecko
Lacertidae	
Pedioplanis hasabensis	Husab Sand Lizard
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon

Source: Kavari (2007)

A survey of the reptiles associated with the Kuiseb River Delta area (approximately 50km southwest of the general Bannerman Water Supply Pipeline Project area) conducted by Cunningham (2019) indicated the presence of 5 reptiles species (2 snakes, 1 burrowing skink, 1 typical skink and 1 lizard) (Table 11).

Table 11. Reptiles recorded in the general Kuiseb River Delta area.

Family and Scientific name	Common name
Typical snakes	

Family and Scientific name	Common name
Bitis arietans	Puff Adder
Bitis caudalis	Horned Adder
Skinks	
Typhlacontias brevipes	FitzSimmons' Burrowing Skink
Trachylepis variegata variegata	Variegated Skink
Lacertidae	
Meroles reticulatus	Reticulated Desert Lizard

Source: Cunningham (2019)

A survey of the reptiles associated with the Tumas area (approximately 50km southeast of the general Bannerman Water Supply Pipeline Project area) conducted by Cunningham (2020) indicated the presence of 6 reptiles species (1 snake, 2 typical skinks and 1 Old World lizard and 2 geckos) (Table 12).

Table 12. Reptiles recorded in the general Tumas area.

Species: Scientific name	Species: Common name
Typical Snakes	
Psammophis leightoni namibensis	Namib Sand Snake
LIZARDS	
Skinks	
Typhlacontias brevipes	FitzSimon's Burrowing Skink
Trachylepis sulcata	Western Rock Skink
Old World Lizards	
Meroles reticulatus	Reticulated Desert Lizard
Geckos	
Phelsuma (Rhoptropus) afer	Common Namib Day Gecko
Phelsuma (Rhoptropus) bradfieldi	Bradfield's Namib Day Gecko

Source: Cunningham (2020)

Pipeline impact
The impact of heavy machinery during excavation of a trench to bury the proposed water pipeline is expected to be detrimental to reptiles associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

The impact of above/below ground pipeline infrastructure is not expected to be detrimental to reptiles – i.e. would not impede their movement, etc.

Furthermore, none of the unique/important species are exclusively associated with the proposed development area.

6.1.2 Amphibian Diversity

Amphibian diversity known and/or expected to occur in the general Bannerman Water Supply Pipeline Project area (literature study only), is presented in Table 13.

Table 13. Amphibian diversity expected to occur in the general Bannerman Water Supply Pipeline Project area – literature study.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status
Toads			
Amietophrynus poweri	Western Olive Toad		LC
Poyntonophrynus hoeschi	Hoesch's Pygmy Toad	Endemic	LC
Rubber Frog			
Phrynomantis annectens	Marbled Rubber Frog	Endemic	LC
Sand Frogs			
Tomopterna tandyi	Tandy's Sand Frog		LC
Platannas			
Xenopus laevis	Common Platanna		LC

Endemic – Griffin (1998b)
IUCN (2021): LC – Least Concern
Source for literature review: Carruthers (2001), Channing (2001), Channing and Griffin (1993), Du Preez and Carruthers (2009), Griffin (1998b), IUCN (2021), Passmore and Carruthers (1995)

Amphibians are declining throughout the world due to various factors of which much has been ascribed to habitat destruction. Basic species lists for various habitats are not always available with Namibia being no exception in this regard while the basic ecology of most species is also unknown. Approximately 4,000 species of amphibians are known worldwide with just over 200 species known from southern Africa and at least 57 species expected to occur in Namibia. Griffin (1998b) puts this figure at 50 recorded species and a final species richness of approximately 65 species, 6 of which are endemic to Namibia. This "low" number of amphibians from Namibia is not only as a result of the generally marginal desert habitat, but also due to Namibia being under studied and under collected. Most amphibians require water to breed and are therefore associated with the permanent water bodies, mainly in northeast Namibia. Desert areas are marginal habitat for amphibians.

According to Mendelsohn *et al.* (2002), the overall frog diversity in the general area is estimated at between 1-3 species. Griffin (1998b) puts the species richness in the general area at 2 species.

At least 5 species of amphibians can occur in suitable habitat in the general area (Du Preez and Carruthers 2009). The area is under represented, with 2 toads and 1 species each for rubber, sand and platanna known and/or expected to occur in the area (i.e. potentially could be found in the area). Of these, 2 species are endemic (*Poyntonophrynus hoeschi* and *Phrynomantis annectens*) (Griffin 1998b) – i.e. high level (40%) of amphibians of conservation value from the general area. The IUCN (2021) classifies all the species as least concern.

The most important species are the 2 endemics although they are widespread throughout Namibia and not specifically associated with the Bannerman Water Supply Pipeline Project area. Overall suitable habitat for amphibians in the general area is viewed as the ephemeral Khan, Kuiseb, Swakop and Tumas Rivers and their tributaries. Temporary pools after localised rainfall events could potentially serve as habitat for amphibians throughout the area. None of the unique/important amphibian species are exclusively associated with the proposed Bannerman Water Supply Pipeline Project area.

The area is extremely marginal with very little rainfall generally occurring in the area (<50mm annual average) and being highly variable (>100% coefficient of variation) and sporadic of nature (Mendelsohn *et al.* 2002). Furthermore, no amphibians were observed at the Inca and TRS sites (Cunningham 2010); the Ongolo and Tumas areas (Cunningham 2013); the Marenica area (Spitzkoppe area) by Henschel *et al.* (2011) or the Tumas area (Cunningham 202), either.

However, the general area undoubtedly has suitable, albeit temporary of nature, amphibian habitat during the rainy season (or where rainfall does occur) when pools could collect in the Swakop and Tumas Rivers and their tributaries and more especially in rocky hollows. The amphibians expected to occur in the general area are however not exclusively associated with the Bannerman Water Supply Pipeline Project area with the 2 endemics that could potentially occur in the area occurring widespread throughout Namibia and not specifically associated with the proposed development sites.

Pipeline impact
The impact of above/below ground pipeline infrastructure is not expected to be detrimental to amphibians – i.e. would not affect their habitat or impede their movement, etc.

Furthermore, none of the unique/important species are exclusively associated with the proposed development area.

6.1.3 Mammal Diversity

Mammal diversity known and/or expected to occur in the Bannerman Water Supply Pipeline Project area (literature study only), is presented in Table 14.

Namibia is well endowed with mammal diversity with at least 250 species occurring in the country. These include the well known big and hairy as well as a legion of smaller and lesser-known species. Currently 14 mammal species are considered endemic to Namibia of which 11 species are rodents and small carnivores of which very little is known. Most endemic mammals are associated with the Namib and escarpment with 60% of these rock-dwelling (Griffin 1998c). According to Griffin (1998c) the endemic mammal fauna is best characterized by the endemic rodent family *Petromuridae* (Dassie rat) and the rodent genera *Gerbillurus* and *Petromyscus*.

Overall terrestrial diversity and endemism – all species – is classified as “low” and “average” respectively in the western central part of Namibia (Mendelsohn *et al.* 2002). The overall diversity (1-2 species) and abundance of large herbivorous mammals is “low” in the general Arandis area with oryx and springbok having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall abundance and diversity of large carnivorous mammals is “average” (4 species) in the general area with brown hyena having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall mammal diversity in the general area is estimated at between 16-30 species with 3-4 species being endemic to the area (Mendelsohn *et al.* 2002). Griffin (1998c) puts the species richness distribution of endemics also between 3-4 species in the general area while the Namib-Naukluft Park has an estimated 80 species in total and the neighbouring Skeleton Coast National Park has at least 87 species of mammals.

At least 49 species of mammals are known and/or expected to occur in the general area of which 8 species (16.3%) are classified as endemic (Table 3). The Namibian legislation classifies 5 species as vulnerable, 1 species as rare, 2 species as insufficiently known, 1 species as specially protected game, 5 species as protected game, 4 species as huntable game, 3 species as problem animals, 1 species as invasive alien, 1 species as a migrant and 1 species is not listed. At least 28.6% (14 species) of the mammalian fauna that occur or are expected to occur in general area are represented by rodents of which 3 species (21.4%) are endemic. This is followed by bats with 13 species (26.5%) of which 1 species is listed as endemic and rare (7.7%) and carnivores with 11 species (22.5%) of which 1 species (9.1%) is endemic and 5 species listed as vulnerable (45.5%).

Fourteen species (28.6%) have international conservation status (some species more than 1 classification) of which 3 species classified as vulnerable and 1 species as near threatened by the IUCN (2021) while 1 species is classified as endangered, 2 species as vulnerable and

Table 14. Mammal diversity expected to occur in the general Bannerman Water Supply Pipeline Project area – literature study.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
Elephant Shrews					
Macroscelides proboscideus flavicaudatus	Round-eared Elephant-shrew	Endemic; Secure			
Aardvark					
Orycteropus afer	Aardvark	Secure; Protected Game			
Bats					
Eidolon helvum	African Straw-coloured Fruit Bat	Secure; Migrant			
Rhinolophus darlingi	Darling's Horseshoe Bat	Secure; Peripheral		NT	
Rhinolophus fumigatus	Rűppell's Horseshoe Bat	Secure		NT	
Taphozous mauritianus	Mauritian Tomb Bat	Secure			
Nycteris thebaica	Egyptian Slit-faced Bat	Secure			
Sauromys petrophilus	Robert's Flat-headed Bat	Secure			
Tadarida aegyptiaca	Egyptian Free-tailed Bat	Secure			
Miniopterus natalensis	*Natal Long-fingered Bat	Secure		NT	
Cistugo seabrai	*Namibian Wing-gland Bat	Endemic; Rare		V	
Eptesicus hottentotus	Long-tailed Serotine Bat	Secure			
Mimetillus thomasi	Thomas's Flat-headed Bat	Not listed			
Neoromicia zuluensis	Zulu Serotine Bat	Secure			
Pipistrellus rueppellii	Rűppell's Pipistelle Bat	Insufficiently known; Peripheral			
Hares and Rabbits					
Lepus capensis	Cape Hare	Secure			
Porcupine					
Hystrix africeaustralis	Porcupine	Secure			
Rats and Mice					
Petromys typicus	Dassie Rat	Endemic; Secure		NT	
Pedetes capensis	Springhare				
Rhabdomys pumilio	Four-striped Grass Mouse	Secure			
Mastomys coucha	Southern Multimammate Mouse	Secure			
Aethomys chrysophilus	Red Veld Rat	Secure			
Aethomys namaquensis	Namaqua Rock Mouse	Secure			
Protomys littledalei namibensis	Littledale's Whistling Rat	Endemic		NT	
Desmodillus auricularis	Cape Short-tailed Gerbil	Secure			
Gerbillurus paeba	Hairy-footed Gerbil	Secure			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
Gerbillurus setzeri	Setzer's Hairy-footed Gerbil	Endemic			
Petromyscus collinus	Pygmy Rock Mouse	Endemic; Secure			
Mus musculus	House Mouse	Invasive alien			
Primates					
Papio ursinus	Chacma Baboon	Secure; Problem animal			C2
Carnivores					
Parahyaena (Hyaena) brunnea	Brown Hyena	Insufficiently known; (Vulnerable?); Peripheral	NT	NT	
Crocuta crocuta	Spotted Hyena	Secure?; Peripheral	NT		
Felis silvestris	African Wild Cat	Vulnerable			C2
Suricata suricatta marjoriae	Suricate	Endemic; Secure			
Otocyon megalotis	Bat-eared Fox	Vulnerable(?); Peripheral; Protected Game			
Vulpes chama	Cape Fox	Vulnerable?			
Canis mesomelas	Black-backed Jackal	Secure; Problem animal			
Ictonyx striatus	Striped Polecat	Secure			
Mellivora capensis	Ratel	Secure; Protected Game			
Acinonyx jubatus	Cheetah	Vulnerable; Protected Game	V	V	C1
Caracal caracal	Caracal	Secure; Problem animal			C2
Panthera pardus	Leopard	Secure(?); Peripheral; Protected Game		V	C1
Pigs					
Phacochoerus africanus	Warthog	Secure; Huntable game			
Zebra					
Equus zebra hartmannae	Hartmann's Mountain Zebra	Endemic; Secure; Specially Protected Game	E	V	C2
Antelopes					
Oryx gazella	Gemsbok	Secure; Huntable game			
Tragelaphus strepsiceros	Kudu	Secure; Huntable game			
Sylvicapra grimmia	Common Duiker	Secure			
Antidorcas marsupialis	Springbok	Secure; Huntable game			
Raphicerus campestris	Steenbok	Secure; Protected Game			

SARDB (2004): NT – Near Threatened, V – Vulnerable
IUCN (2021): V – Vulnerable, NT – Near Threatened, All the other species are listed as: LC – Least Concern
CITES: CITES Appendix 1 or 2 species
* - Monandjem *et al.* (2010): NT – Near Threatened

Source for literature review: Cunningham (2013), Cunningham (2020), De Graaff (1981), Estes (1995), Griffin and Coetzee (2005), IUCN (2021), Joubert and Mostert (1975), Monandjem *et al.* (2010), Skinner and Smithers (1990), Skinner and Chimimba (2005), Stander and Hannsen (2003) and Taylor (2000)

7 species as near threatened and by the SARDB (2004) and 6 species as either CITES Appendix 1 (2 species) and 2 (4 species) species. The house mouse (*Mus musculus*) is viewed as an invasive alien species to the area. *Mus musculus* are generally known as casual pests and not viewed as problematic although they are known carriers of "plague" and can cause economic losses. Although the brown and house rats are expected to occur in Walvis Bay and Swakopmund, they are commensally with humans and could occur in the general area – i.e. Arandis, Swakopmund and the Husab/Langer Heinrich/Rössing Mine areas – although they probably do not yet occur in the Bannerman Water Supply Pipeline Project area.

The most important species from the general area are the Namibian wing-gland bat (*Cistugo seabrai*) listed as endemic and rare; Littledale's whistling rat (*Protomys littledalei namibensis*) – of which the subspecies "*namibensis*" is known to occur in the ephemeral river courses in the "Swakopmund area" Griffin (2003) – listed as endemic; brown hyena (*Parahyaena brunnea*) and leopard (*Parthera pardus*) listed as near threatened and vulnerable (population trends decreasing), respectively by the IUCN (2021). However, leopard is only expected to occasionally pass through the area as the general area is not viewed as favoured habitat.

Habitat alteration and overutilization are the two primary processes threatening most mammals (Griffin 1998c) with species probably underrepresented in Table 14 for the general area being the bats and rodents, as these groups have not been well documented from the arid central western part of Namibia.

According to Cunningham (2013, 2020) between 12 and 15 species of mammals were observed and/or confirmed (e.g. evidence thereof found) from the neighbouring Tumas and Ongolo areas. However, some of these species – e.g. cheetah, kudu, leopard, warthog, etc. – are species that are expected to occasionally pass through the area, depending on environmental conditions, and not thought to remain in the area throughout the year due to the overall marginal habitat for these species. Furthermore, only 9 large mammal species (oryx, springbok, steenbok, brown hyena, black-backed jackal, bat-eared fox, Cape fox, aardvark and porcupine) and 7 small mammal species of which 3 species were rodents caught in small mammal traps (suricate, dassie rat, ground squirrel, round-eared elephant-shrew, Namaqua rock mouse, four-striped grass mouse and Setzer's hairy-footed gerbil) were observed at Marenica (Spitzkoppe area) by Henschel *et al.* (2011). However, none of the mammal species expected and/or observed/confirmed from the general area (See Cunninghan 2013, 2020, Henschel *et al.* 2011) is exclusively associated with the Bannerman Water Supply Pipeline Project area.

Pipeline impact

The impact of heavy machinery during excavation of a trench to bury the proposed water pipeline is expected to be detrimental to mammals associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

Height

A detailed study on the effects of an aboveground pipeline infrastructure on vertebrate fauna was conducted by Cunningham et al. (2015) on a 40km section from the Swakopmund Base Station to the Langer Heinrich Mine junction. Heights, crossing points and species affected were assessed. It was determined that most springbok crossed the pipeline with heights between 40-70cm (91.1%) with the greatest number crossing at 50-60cm (44%) while gemsbok crossed with difficulty (e.g. individuals only) at 60cm. This indicates that a pipeline height of >70cm is an effective barrier to most springbok and >60cm for gemsbok while anything >80cm is a total barrier (e.g. only 0.4% of springbok crossings were above 80cm) (Cunningham et al. 2015). Although springbok have been observed crossing cattle fences of

1.5m when pressed, often with fatalities, most avoid this height (Pers. obs.). Mountain zebra are expected to be similarly negatively affected while kudu, a typical jumping species, is not affected.

The effect of aboveground pipeline infrastructure >80cm is expected to be detrimental to most ungulates – i.e. would impede their movement, etc. As the existing aboveground pipeline(s) already act as a barrier to most ungulates (Cunningham et al. 2015) the cumulative impact of another aboveground pipeline, running adjacent these pipelines, is not expected to increase the barrier effect.

Crossing Points
Ungulate activity is associated with the availability of vegetation, especially along ephemeral drainage lines. Most pipeline crossing attempts were made in the vicinity of vegetated drainage lines (Cunningham et al. 2015).

Raised – earth covered – crossing points, 30m in width were not used by ungulates while buried sections did not impede movements at all (Cunningham et al. 2015).

Pipeline infrastructure >80cm in height would be viewed as an effective barrier to most ungulates while belowground crossing points would be best situated at drainage lines.

To prevent the pipeline serving as a barrier to ungulates, it would be recommended to bury the pipeline along the entire route from the T/Off section to the Terminal Reservoir. Where it follows the existing pipeline infrastructure from Swakopmund it should mimic the current crossing points and leave enough space between the pipelines for maintenance purposes.

Furthermore, none of the unique/important species are exclusively associated with the proposed development area.

6.1.4 Avian Diversity

Bird diversity known and/or expected to occur in the Bannerman Water Supply Pipeline Project area (literature study only), is presented in Table 15. This table excludes coastal marine birds although some may occasionally occur in the area (e.g. gulls and terns), migratory birds (e.g. Petrel, Albatross, Skua, etc.) and species breeding extralimital (e.g. stints, sandpipers, etc.) and rather focuses on birds that are breeding residents or can be found in the area during any time of the year. This would imply that many more birds (e.g. Palaearctic migrants) could occur in the area depending on "favourable" environmental conditions.

Although Namibia's avifauna is comparatively sparse compared to the high rainfall equatorial areas elsewhere in Africa, approximately 658 species have already been recorded with a diverse and unique group of arid endemics (Brown *et al.* 1998, Maclean 1985). Fourteen species of birds are endemic or near endemic to Namibia with the majority of Namibian endemics occurring in the savannas (30%) of which ten species occur in a north-south belt of dry savannah in central Namibia (Brown *et al.* 1998).

Bird diversity is viewed as "average" in the general area with 141-170 species estimated and 1-3 species being endemic (Mendelsohn *et al.* 2000). Simmons (1998a) suggests 4-6 endemic species and a "low to average" ranking for southern African endemics and "high" ranking for southern African red data birds expected from the general area. The Bannerman Water Supply Pipeline Project area does not fall within an Important Birding Area (IBA). Important Birding Areas which are in the general vicinity include Walvis Bay (global IBA status), Sandwich Harbour (global IBA status), 30 km beach (national IBA status) and the Mile 4 Saltworks (global IBA status) (Simmons 1998a) all approximately 20-50km towards the west along the coast.

Table 15. Avian diversity expected to occur in the general Bannerman Water Supply Pipeline Project area – literature study.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
Struthio camelus	Common Ostrich			
Pternistis adspersus	Red-billed Spurfowl		N-end	
Numida meleagris	Helmeted Guineafowl			
Dendropicos namaquus	Bearded Woodpecker			
Tockus monteiri	Monteiro's Hornbill	End		
Tockus damarensis	Damara Hornbill	End	N-end	
Tockus leucomelas	Southern yellow-billed Hornbill		N-end	
Tockus nasutus	African Grey Hornbill			
Upupa africana	African Hoopoe			
Phoeniculus purpureus	Green Wood-Hoopoe			
Rhinopomastus cyanomelas	Common Scimitarbill			
Colius colius	White-backed Mousebird		End	
Urocolius indicus	Red-faced Mousebird			
Poicephalus rueppellii	Rüppell's Parrot	End; NT	N-end	
Agapornis roseicollis	Rosy-faced Lovebird	End	N-end	
Cypsiurus parvus	African Palm Swift			
Tachymarptis melba	Alpine Swift			
Apus bradfieldi	Bradfield's Swift		N-end	
Apus affinis	Little Swift			
Apus caffer	White-rumped Swift			
Corythaixoides concolor	Grey Go-away Bird			
Tyto alba	Barn Owl			
Ptilopsis granti	Southern White-faced Scops Owl			
Bubo capensis	Cape Eagle-Owl	NT		
Bubo africanus	Spotted Eagle Owl			
Bubo lacteus	Verreaux's Eagle-Owl			
Glaucidium perlatum	Pearl-spotted Owlet			
Asio capensis	Marsh Owl			
Columba livia	Rock Dove			
Columba guinea	Speckled Pigeon			
Streptopelia capicola	Cape Turtle Dove			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
Streptopelia senegalensis	Laughing Dove			
Oena capensis	Namaqua Dove			
Neotis ludwigii	Ludwig's Bustard	E	N-end	E
Ardeotis kori	Kori Bustard	NT		NT
Eupodotis rueppellii	Rüppell's Korhaan	End	N-end	
Pterocles namaqua	Namaqua Sandgrouse		N-end	
Pterocles bicinctus	Double-banded Sandgrouse		N-end	
Vanellus armatus	Blacksmith Lapwing			
Rhinoptilus africanus	Double-banded Courser			
Elanus caeruleus	Black-shouldered Kite			
Aegypius tracheliotos	Lappet-faced Vulture	V		E
Gyps africanus	White-backed Vulture	E		CE
Circaetus pectoralis	Black-chested Snake-Eagle			
Melierax canorus	Southern Pale Chanting Goshawk		N-end	
Melierax gabar	Gabar Goshawk			
Accipiter badius	Shikra			
Circus maurus	Black Harrier	E	End	E
Buteo augur	Augur Buzzard			
Aquila verreauxii	Verreaux's Eagle	NT		
Polemaetus bellicosus	Martial Eagle	E		V
Aquila rapax	Tawny Eagle	E		V
Aquila pennatus	Booted Eagle	E		
Sagittarius serpentarius	Secretarybird	V		V
Falco rupicolus	Rock Kestrel			
Falco rupicoloides	Greater Kestrel			
Falco chicquera	Red-necked Falcon			
Falco biarmicus	Lanner Falcon			
Falco peregrinus	Peregrine Falcon	NT		
Ciconia nigra	Black Stork	E		
Egretta garzetta	Little Egret			
Ardea cinerea	Grey Heron			
Ardea melanocephala	Black-headed Heron			
Bubulcus ibis	Cattle Egret			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
Scopus umbretta	Hamerkop			
Dicrurus adsimilis	Fork-tailed Drongo			
Nilaus afer	Brubru			
Tchagra australis	Brown-crowned Tchagra			
Telophorus zeylonus	Bokmakierie		N-end	
Batis pririt	Pririt Batis		N-end	
Corvus capensis	Cape Crow			
Corvus albus	Pied Crow			
Lanius collaris	Common Fiscal			
Parus cinerascens	Ashy Tit		End	
Riparia paludicola	Brown-throated Martin			
Hirundu albigularis	White-throated Swallow			
Hirundo dimidiata	Pearl-breasted Swallow			
Hirundo fuligula	Rock Martin			
Pycnonotus nigricans	African Red-eyed Bulbul		N-end	
Sylvietta rufescens	Long-billed Crombec			
Eremomela icteropygialis	Yellow-bellied Eremomela			
Eremomela gregalis	Karoo Eremommela		End	
Parisoma layardi	Layard's Tit-Babbler		End	
Parisoma subcaeruleum	Chestnut-vented Tit-Babbler		N-end	
Zosterops pallidus	Orange River White-eye		End	
Cisticola subruficapilla	Grey-backed Cisticola		N-end	
Cisticola juncidis	Zitting Cisticola			
Cisticola jaridulus	Desert Cisticola			
Prinia flavicans	Black-chested Prinia			
Mirafra sabota	Sabota Lark			
Ammomanopsis grayi	Gray's Lark	End		
Certhilauda subcoronata	Karoo Long-billed Lark		End	
Eremopterix verticalis	Grey-backed Sparrowlark		N-end	
Calandrella cinerea	Red-capped Lark			
Alauda starki	Stark's Lark		N-end	
Bradornis infuscatus	Chat Flycatcher		N-end	
Melaenornis mariquensis	Marico Flycatcher		N-end	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
Muscicapa striata	Spotted Flycatcher			
Cercotrichas paena	Kalahari Scrub-Robin			
Namibornis herero	Herero Chat	End	N-end	
Oenanthe monticola	Mountain Wheatear		N-end	
Oenanthe pileata	Capped Wheatear			
Cercomela schlegelii	Karoo Chat		N-end	
Cercomela tractrac	Tractrac Chat		N-end	
Cercomela familiaris	Familiar Chat			
Myrmecocichla formicivora	Ant-eating Chat		End	
Onychognathus nabouroup	Pale-winged Starling		N-end	
Lamprotornis nitens	Cape Glossy Starling			
Creatophora cinerea	Wattled Starling			
Chalcomitra senegalensis	Scarlet-chested Sunbird			
Nectarinia fusca	Dusky Sunbird		N-end	
Sporopipes squamifrons	Scaly-feathered Finch		N-end	
Plocepasser mahali	White-browed Sparrow-Weaver			
Philetairus socius	Sociable Weaver		End	
Ploceus velatus	Southern Masked-Weaver			
Quelea quelea	Red-billed Quelea			
Amadina erythrocephala	Red-headed Finch		N-end	
Estrilda erythronotos	Black-faced Waxbill			
Estrilda astrild	Common Waxbill			
Passer domesticus	House Sparrow			
Passer motitensis	Great Sparrow		N-end	
Passer melanurus	Cape Sparrow		N-end	
Passer griseus	Southern Grey-headed Sparrow			
Motacilla capensis	Cape Wagtail			
Crithagra atrogulariis	Black-throated Canary			
Serinus flaviventris	Yellow Canary		N-end	
Serinus albogularis	White-throated Canary		N-end	
Emberiza impetuani	Lark-like Bunting		N-end	
Emberiza tahapisi	Cinnamon-breasted Bunting			
Emberiza capensis	Cape Bunting		N-end	

Namibian status: Simmons *et al.* (2015)
Southern African status: Hockey *et al.* (2006)
International status: IUCN (2021)
Source for literature review: Brown *et al.* (1998), Cunningham (2013), Cunningham (2020), Hockey *et al.* (2006), IUCN (2021), Komen (n.d.), Little and Crowe (2011), Maclean (1985) Peacock (2015), Simmons *et al.* (2015), Tarboton (2001)

At least 130 species of terrestrial ["breeding residents"] birds occur and/or could occur in the general area at any time (Hockey *et al.* 2006, Maclean 1985, Tarboton 2001). All the migrant and aquatic species have been excluded here. Seven of the 14 Namibian endemics are expected to occur in the general area (50% of all Namibian endemic species or 5.4% of all the species expected to occur in the area). However, Simmons *et al.* (2015) indicates that Rüppell's parrot is viewed as near endemic. Furthermore, Simmons *et al.* (2015) list 7 species as endangered (Ludwig's bustard, white-backed vulture, black harrier, martial eagle, tawny eagle, booted eagle, black stork), 2 species as vulnerable (Lappet-faced vulture, secretarybird) and 5 species as near threatened (Rüppell's parrot, Cape eagle owl, kori bustard, Verreaux's eagle and peregrine falcon). Other important species known to occur in the general area but not included in Table 15 are maccoa duck (NT) and great white pelican (V). Both these species are however aquatic species and not expected to occur in the Bannerman Water Supply Pipeline Project area, but probably only pass over on their way to the coast.

Forty three species have a southern African conservation rating with 9 species classified as endemic (20.1% of southern African endemics or 7% of all the birds expected) and 34 species classified as near endemic (79.1% of southern African endemics or 26.2% of all the birds expected) (Hockey *et al.* 2006). The IUCN (2021) lists 1 species as critically endangered (white-backed vulture), 3 species as endangered (Ludwig's bustard, lappet-faced vulture, black harrier), 3 species as vulnerable (martial eagle, tawny eagle, secretary bird) and 1 species as near threatened (kori bustard).

The most important birds known/expected to occur in the general area are all the endemics (See Table 15), especially Rüppels korhaan, Gray's lark and Herero chat. Gray's lark is one of the species with the most restricted range in Namibia (Simmons 1998a). Other important species are the birds listed as endangered (Ludwig's bustard, white-backed vulture, black harrier, martial eagle, tawny eagle, booted eagle, black stork), vulnerable (Lappet-faced vulture, secretarybird) and near threatened (Rüppell's parrot, Cape eagle owl, kori bustard, Verreaux's eagle and peregrine falcon) by Simmons *et al.* (2015) and the species classified as critically endangered (white-backed vulture), endangered (Ludwig's bustard, lappet-faced vulture, black harrier), vulnerable (martial eagle, tawny eagle, secretary bird) and near threatened (kori bustard) by the IUCN (2021).

According to Cunningham (2010, 2013, 2020) between 8 (2010), 13 (2020) and 17 (2013) species of birds were observed and/or confirmed (e.g. evidence thereof found) from the neighbouring INCA/TRS, Tumas and Ongolo areas. Furthermore, only 12 bird species were observed at Marenica (Spitzkoppe area) by Henschel *et al.* (2011).

However, none of the bird species expected and/or observed/confirmed from the general area (See Cunninghan 2010, 2013, 2020, Henschel *et al.* 2011) is exclusively associated with the Bannerman Water Supply Pipeline Project area.

Pipeline impact

The impact of heavy machinery during the excavation of a trench to bury the proposed water pipeline is expected to be detrimental to birds, especially ground nesting species (e.g. Rüppel's korhaan, Gray's lark, etc.), associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, an open trench could act as a giant pitfall trap for ostrich and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

Height

A detailed study on the effects of an aboveground pipeline infrastructure on avifauna was conducted by Cunningham et al. (2015) on a 40km section from the Swakopmund Base

Station to the Langer Heinrich Mine junction. Heights; crossing points and species affected were assessed. It was determined that ostrich did not cross the pipeline at all and viewed it as an effective barrier. Other birds were not adversely affected by the pipeline infrastructure. As the existing aboveground pipeline(s) already act as a barrier to ostrich (Cunningham et al. 2015) the cumulative impact of another aboveground pipeline, running adjacent these pipelines, is not expected to increase the barrier effect.

Crossing Points
Ostrich activity is correlated to the availability of vegetation, especially vegetated drainage lines in the Namib.

Raised – earth covered – crossing points, 30m in width were not used by ostrich while buried sections did not impede movements at all (Cunningham et al. 2015).

The effect of aboveground pipeline infrastructure is expected to be detrimental to ostrich – i.e. would impede their movement, etc.

To prevent the pipeline serving as a barrier to ostrich, it would be recommended to bury the pipeline along the entire route from the T/Off section to the Terminal Reservoir. Where it follows the existing pipeline infrastructure from Swakopmund it should mimic the current crossing points and leave enough space between the pipelines for maintenance purposes.

Furthermore, none of the unique/important species are exclusively associated with the proposed development area.

6.2 Important Species

Reptiles
Of the 54 species of reptiles expected to occur in the general area, of which a high percentage are viewed as endemic (53.7%), only 6 species, of which 4 species are endemic (66.7%) were observed/confirmed by Cunningham (2020) while 14 and 26 species were confirmed by Cunningham (2010, 2013) in neighbouring areas, respectively.

The endemic *Pedioplanis husabensis* (Husab Sand Lizard), which is a restricted range species (100% of the taxon's range within Namibia) potentially, occurs in suitable habitat – e.g. "light coloured" geology (marble/granite ridges) – throughout the area. Other reptile species of concern and expected to occur in the general area are the endemic *Afroedura africana africana* (African flat gecko), *Leptotyphlops occidentalis* (western thread snake) and *Lycophidion namibianum* (Namibian wolf snake).

Sedentary species – e.g. most species including all geckos – will be adversely affected by the proposed project developments, however none of the reptiles (with the exception of *P. husabensis* favouring specific geology and habitat throughout the general area) expected to occur in the general area are exclusively associated with the proposed Bannerman Water Supply Pipeline Project area.

Amphibians
Amphibians are not viewed as important throughout the Bannerman Water Supply Pipeline Project area although the ephemeral Swakop and Tumas Rivers and rock pools might occasionally serve as temporary habitat. The endemic *Poyntonophrynus hoeschi* and *Phrynomantis annectens* are viewed as the most important although they are not exclusively associated with the proposed Bannerman Water Supply Pipeline Project area.

Mammals
The most important species from the general area are the Namibian wing-gland bat (*Cistugo seabrai*) listed as endemic and rare; Littledale's whistling rat (*Protomys littledalei namibensis*)

– of which the subspecies "*namibensis*" is known to occur in the ephemeral river courses in the "Swakopmund area" Griffin (2003) – listed as endemic; brown hyena (*Parahyaena brunnea*) and leopard (*Parthera pardus*) listed as near threatened and vulnerable (population trends decreasing), respectively by the IUCN (2021). However, leopard is only expected to occasionally pass through the area as the general area is not viewed as favoured habitat.

Other important species expected to occur in the general area include the African wild cat (*Felis sylvestris*), suffering genetic pollution with domestic cats throughout its range and the endemic Hartmann's mountain zebra (*Equus zebra hartmannae*), classified as "Vulnerable" by the IUCN (2021). However, the Hartmann's mountain zebra favour the better vegetated inland areas and only pass through during foraging and do not necessarily occur in the area permanently.

Sedentary species – e.g. rodents – will be adversely affected by the proposed Bannerman Water Supply Pipeline Project developments and species not being able to negotiate above ground pipeline infrastructures (e.g. Hartmann's mountain zebra); however none are exclusively associated with the proposed development areas.

Birds
The most important birds known/expected to occur in the general area are all the endemics especially Rüppels korhaan, Gray's lark and Herero chat. Gray's lark is one of the species with the most restricted range in Namibia (Simmons 1998a). Other important species are the birds listed as endangered (Ludwig's bustard, white-backed vulture, black harrier, martial eagle, tawny eagle, booted eagle, black stork), vulnerable (Lappet-faced vulture, secretarybird) and near threatened (Rüppell's parrot, Cape eagle owl, kori bustard, Verreaux's eagle and peregrine falcon) by Simmons *et al.* (2015) and the species classified as critically endangered (white-backed vulture), endangered (Ludwig's bustard, lappet-faced vulture, black harrier), vulnerable (martial eagle, tawny eagle, secretary bird) and near threatened (kori bustard) by the IUCN (2021).

Bird species most likely to be adversely affected by the proposed Bannerman Water Supply Pipeline Project developments are the ground nesting species associated with gravel plains such as the endemic Gray's lark and Rüppell's korhaan as well as larger raptors, especially the disturbance at breeding sites (i.e. lappet-faced vulture nesting sites mainly isolated with bigger *Acacia erioloba* trees) and species not being able to negotiate above ground pipeline infrastructures (e.g. ostrich); however none are exclusively associated with the proposed development areas.

6.3 Important areas

The MEFT (2013) views the following strategies regarding habitat units in the Namib Naukluft Park as important:

1. Because of the large open systems involved, and the intention to create linkages with adjacent ecosystems (e.g. coastal and marine to west and escarpment belt to east), ecosystem management should be minimal, and a largely hands-off approach should be adopted, but 'hands-on' in terms of forging strategic partnerships for open landscape conservation and to prevent and/or minimizing damage to important habitats and species in the NNP;
2) Should it become necessary to apply active management, interventions should aim to manage the arid ecosystems for long-term diversity, health, productivity and climate change resilience and adaptation, by ensuring connectivity, preventing over use of all components, including water, fauna and flora, landscapes, etc.;
3) Allow and promote variability in management and "patchiness" in ecosystem expression in response to variable climatic conditions and ecosystem functioning;

4) Build up a good monitoring record of ecological and bio-climatic information, including the diversity and abundance of various species in different taxa, including the less studied lower plants, invertebrates, etc.;
5) Monitor the health of populations of species high on the food chain (e.g. key predators and scavengers), flagship and keystone species and other strategic key indicator species (including indicator species for early warning of climate change impacts) – if these species prosper it follows that the base of the food chain is likely to be diverse and in good condition;
6) Monitor key habitats such as Important Bird Areas and Important Plant Areas;
7) Monitor human impacts on landscapes, ecosystems, habitats and species with particular attention to fragile and high value components of the system, and human activities known to have significant impacts;
8) Participatory and outsourced approaches for monitoring should be used, fully involving relevant stakeholders; and
9) No poisons or pesticides (or other toxic chemicals) may be used in the park unless when approved by the Director responsible for Park Management.

The proposed development area falls within the IUCN Category 2 – i.e. area of medium sensitivity – within the Namib Naukluft Park (MEFT 2013).

Sensitive areas
The areas of most concern (See Figures 2 and 3), presented from most to least importance, would be:

i) Ephemeral drainage lines
The drainage lines throughout the area are mostly tributaries of the ephemeral Swakop and Tumas Rivers which drain the general area westwards towards the coast. These, often well vegetated drainage lines, are virtual lifelines for most vertebrate fauna, especially ungulates, small mammals and birds that forage along these vegetated areas. The drainage lines often pass alongside broken rocky terrain (ecotone areas with increased diversity) which serves as habitat to a wide variety of reptiles – e.g. Namib day geckos. The bigger trees – e.g. mainly *Acacia erioloba* (individuals) – also found along the drainage lines serve as habitat for a variety of species (e.g. lappet-faced vulture nesting/roosting sites as well as other larger raptors and bark/cavity roosting bats, etc.). The entire area – Central Namib Plains – is an amalgamated area with known "red flag" zones (e.g. Hamilton Range [marble inselberg with high plant diversity] and Leeukop [inselberg with very high concentration of *Adenia pechuelli*]) by the 'uranium rush' (SAIEA 2010). According to the MEFT Namib Naukluft Management Plan, the central Namib gravel plains with inselbergs that support plains wildlife such as oryx, springbok and ostrich, are viewed as notable and important features with ephemeral river courses one of the most important habitats (MEFT 2013).

ii) Marble/Granite ridges/rocky outcrops/inselbergs (i.e. light coloured "white and grey" geology)
Ridges, outcrops and inselbergs are generally viewed as unique habitat for vertebrate fauna not necessarily associated with the surrounding plain areas. Various geckos are rock and crevasse dwelling species associated with these landforms. Caves and crevasses also serve as roosting site for bats and owls, etc. The endemic and restricted range species, *Pedioplanis husabensis* (Husab sand lizard), occurs on "light coloured" geology (marble/granite ridges) in the general area (See Cunningham 2013, Cunningham *et al.* 2012). The importance of this general area – Central Namib Plains – for "lizards which seek contrasting substrate" – i.e. *P. husabensis* – is included in the 'uranium rush' (SAIEA 2010). The MEFT (2013) views inselbergs as important from archaeological, biodiversity and aesthetic perspectives while inland rocky hills are less sensitive than inselbergs, but nonetheless important for biodiversity and refugia for plants and animals, particularly during dry periods.

iii) Lappet-faced vulture nesting sites

Lappet-faced vulture nesting sites are known to occur throughout the general area (See Cunningham 2020) and these sites are viewed as important as they are classified as endangered by the IUCN (2021) with population trends decreasing throughout their range. With an estimated of only 5,700 mature individuals; human intrusion and disturbances; utility and service lines and ecosystem modifications are viewed as threats (Birdlife International 2019). Furthermore, disturbances around these nesting sites should be avoided as lapped-faced vultures are known to abandon their nests when disturbed.

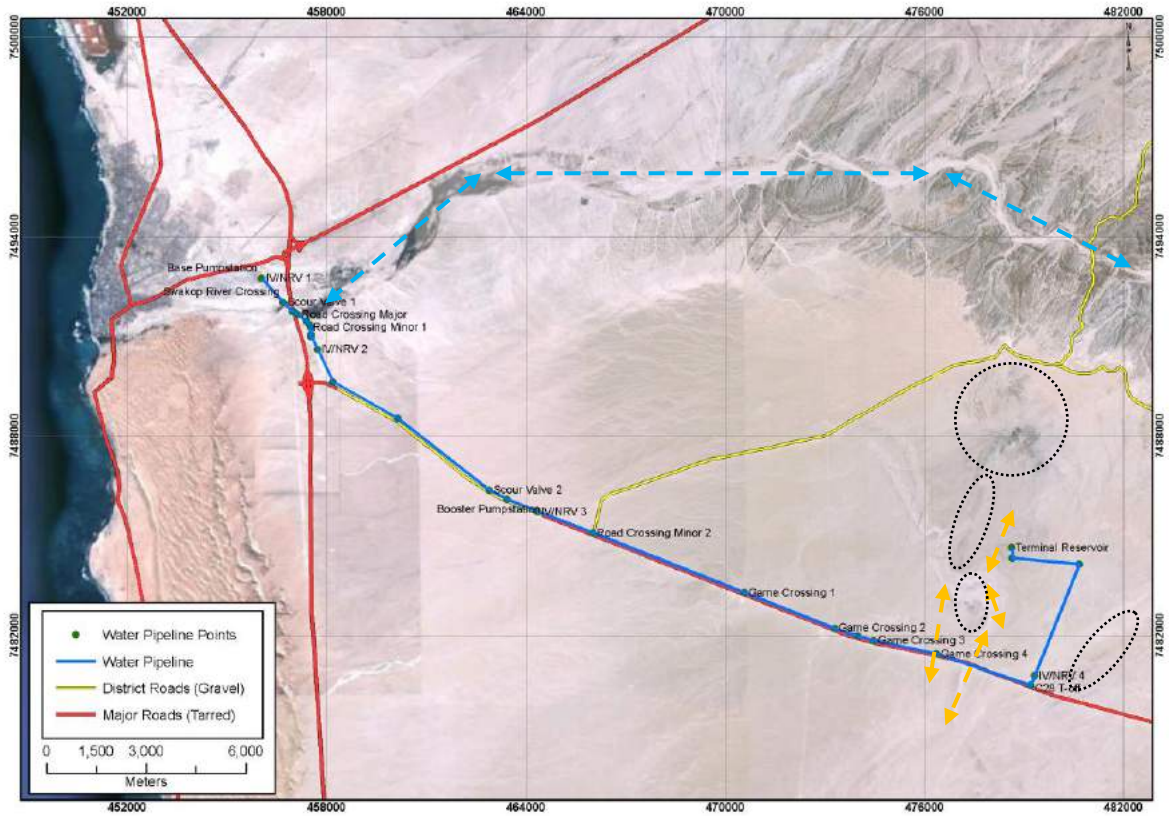

Figure 2. The most important habitat features in the general area are viewed as the Swakop River and its various tributaries (dashed blue arrows); ephemeral drainage lines (dashed orange arrows) and rocky outcrops/ridges, especially “white geology” as potential habitat for the endemic and range restricted Husab sand lizard (dotted black circles/oblongs) (Source: Bannerman).

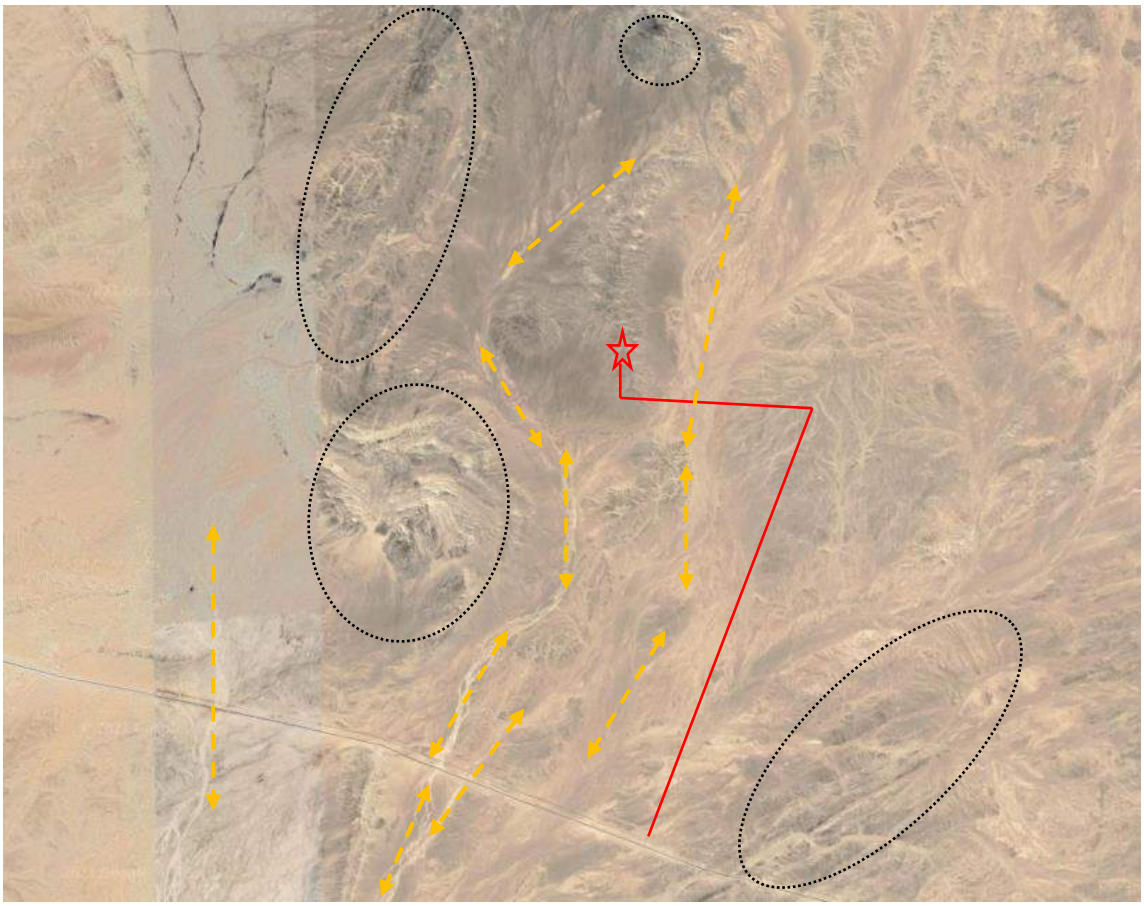

Figure 3. The most important habitat features in the immediate Terminal Reservoir and pipeline area are viewed as the various ephemeral drainage lines (dashed orange arrows) and rocky outcrops/ridges, especially "white geology" as potential habitat for the endemic and range restricted Husab sand lizard (dotted black circles/oblongs). The red star and red lines indicate the approximate location of the Terminal Reservoir and proposed T/Off pipeline route, respectively (Source: Google Earth).

7 Description of Alternatives

Although no alternative pipeline routes were suggested, the following are recommended:

Pipeline

1. Liaise with Reptile Uranium regarding the construction of their proposed new Tumas Pipeline – i.e. 3rd pipeline along this pipeline corridor – rather than constructing a 4th pipeline;
2. The pipeline should follow the existing pipeline corridor and leave sufficient space between the existing two pipelines and the proposed new pipeline for maintenance purposes;
3. All "wildlife crossing points" along the existing aboveground pipeline corridor should be mimicked; and
4. Where the proposed new Bannerman pipeline T/Off deviates north-eastwards from the existing aboveground pipeline corridor it should be buried to avoid it acting as a wildlife barrier.

The 'No Go' option – i.e. without project – could be viewed as the alternative.

The No-Go alternative anticipates changes to the biophysical environment (vertebrate fauna and flora) that would occur in the absence of the proposed project developments. The

environment is not static with the main drivers of change expected to be abstraction of groundwater, climate change (drought) and poaching, etc.

However, the biggest driver of change would probably be human influences altering the habitat to suit their needs – e.g. mining activities, etc. In this scenario vertebrate fauna and sensitive habitats would be affected by changes in land use, etc. Therefore, the anticipated impact of the No-Go scenario on the biophysical environment (vertebrate fauna) is expected to be minor-negative over time.

8 Impact Description and Assessment

8.1 Introduction

All development changes are destructive to the local fauna to some or other degree. Assessing potential impacts is occasionally obvious, but more often difficult to predict accurately. Such predictions may change depending on the scope of the development – i.e. development, once initiated, and may have a different effect on the fauna as originally predicted. Thus continuing monitoring of such impacts during the development phase(s) is imperative.

8.2 Impact Assessment

The following impacts are viewed as the most important regarding the proposed pipeline developments.

Impact 1: Movement of vertebrate fauna (ungulates & ostrich) affected due to the building of the pipeline.

a) Construction Phase

Impact description	Vertebrate fauna habitat affected; open trench a pitfall trap and above ground pipeline would affect ungulate and ostrich movement.	
Intensity: Low The two existing above ground pipelines minimises the intensity of a third pipeline following the same route/corridor.	Extent: Low The footprint is small and negated by the existing pipelines along the same route/corridor.	Duration: Low The construction period is short and footprint is small.
Consequence: Moderate	Probability: High Habitat along drainage lines used for foraging would be affected; open trench would act as “pitfall trap”; pipeline would act as a barrier along movement corridor(s) – i.e. well vegetated drainage lines.	Significance: Moderate

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Sensitive habitats – i.e. 1) ephemeral drainage lines,

	2) marble/granite ridges/outcrops with "light coloured" geology potentially serving as habitat to the endemic and range restricted Husab sand lizard, and 3) lapped-faced vulture nest sites – should be avoided. Liaise with Reptile Uranium to join their proposed pipeline (i.e. 3rd pipeline along pipeline corridor) rather than constructing a 4th pipeline; Mimic the "wildlife crossing" points along the existing pipelines – i.e. follow the same pipeline corridor; Leave enough space between the pipelines for maintenance purposes; Bury pipeline, where possible (depending on geology), from T/Off north-eastwards to the Terminal Reservoir area; and Avoid leaving an open trench overnight and/or leave access routes at each end of the trench.	
Intensity: Very low Vertebrate fauna accustomed to the existing pipeline infrastructures with a third pipeline not adding significantly to the perceived impacts, especially if mitigations followed.	Extent: Low Local impacts on the movement of ungulates and ostrich.	Duration: Low The construction period is short and footprint is small.
Consequence: Low	Probability: High	Significance: Low

b) Operational Phase

Impact description	Above ground pipeline would affect ungulate and ostrich movement.	
Intensity: Low The two existing above ground pipelines minimises the intensity of a third pipeline following the same route/corridor.	Extent: Moderate The existing pipelines along the route/corridor were not originally buried and consequently act as a barrier. Adding a third pipeline to the route would not exacerbate this.	Duration: Moderate The existing pipelines along the route/corridor were not originally buried and consequently act as a barrier. Adding a third pipeline to the route would not exacerbate this.
Consequence: Moderate	Probability: Very High A third pipeline would act as a barrier along movement corridor(s) – i.e. well vegetated drainage lines.	Significance: Very High

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Sensitive habitats – i.e. 1) ephemeral drainage lines, 2) marble/granite ridges/outcrops with "light coloured" geology potentially serving as habitat to the endemic and

	range restricted Husab sand lizard, and 3) lapped-faced vulture nest sites – should be avoided. Bury pipeline, where possible (depending on geology) from T/Off north-eastwards to the Terminal Reservoir area.	
Intensity: Low Vertebrate fauna accustomed to the existing pipeline infrastructures with a third pipeline not adding significantly to the perceived impacts, especially if mitigations followed.	Extent: Moderate Local impacts on movement of ungulates and ostrich.	Duration: Moderate The existing pipelines along the route/corridor were not originally buried and consequently act as a barrier. Adding a third pipeline to the route would not exacerbate this.
Consequence: Moderate to Low	Probability: High	Significance: Moderate to Low

c) Decommissioning/Rehabilitation Phase

Impact description	Vertebrate fauna habitat affected.	
Intensity: Moderate This would depend on if all the three pipelines are rehabilitated.	Extent: Low The footprint is small.	Duration: Moderate The rehabilitation period is short and footprint is small.
Consequence: Moderate	Probability: Moderate Active rehabilitation is not always garuanteed and/or as successfull as natural rehabilitation.	Significance: Moderate

Assessment assuming that all mitigation measures are effectively implemented:

Mitigation measures	Recreate habitats that are favourable to unique species should these have been damaged and/or destroyed during the construction and operational phases – i.e. replant vegetation to recreate the original habitat to lure species (colonisers).	
Intensity: Low	Extent: Low	Duration: Moderate
Consequence: Moderate to Low	Probability: Moderate	Significance: Moderate to Low

9 Conclusion and Recommendations

This report should assist with the planning of the final layout – i.e. sensitive habitats/areas/features to avoid in favour of other less sensitive areas.

The most sensitive areas to avoid as far as possible (See Section 6.3 and Figures 2 and 3) would be:

1) Ephemeral drainage lines;

2) Marble/Granite ridges/rocky outcrops/inselbergs (i.e. light coloured “white and grey” geology); and
3) Lappet-faced vulture nesting sites (should these occur).

Planning of the pipeline route, especially the T/Off north-eastwards to the Terminal Reservoir, should take cognisance of the above sensitive habitats/areas/features and attempt not to disrupt wildlife corridors (e.g. foraging areas, especially vegetated drainage lines) and the overall interconnectivity of various habitats.

The pipeline from the T/Off north-eastwards to the Terminal Reservoir be placed below ground so as not to act as a barrier for ungulates/ostrich or if above ground due to terrain restrictions, then with ungulate/ostrich crossing points at drainage lines (i.e. below ground sections favoured at these sites).

The pipeline should follow a similar corridor to the existing pipelines to minimise the cumulative effect and overall impact on the environment.

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Appendix H: Archaeological Specialist Study

29 October 2021

ASEC cc
Windhoek
Namibia

For attention: Ms Alexandra Speiser

ARCHAEOLOGICAL DESK ASSESSMENT OF THE ETANGO-8 WATER PIPELINE, ERONGO REGION, NAMIBIA

DECLARATION

I hereby declare that I do:

(a) have knowledge of and experience in conducting assessments, including knowledge of Namibian legislation, specifically the National Heritage Act (27 of 2004), as well as regulations and guidelines that have relevance to the proposed activity;

(b) perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

I also declare that I have no interests or involvement in:

(i) the financial or other affairs of either the applicant or his consultant

(ii) the decision-making structures of the National Heritage Council of Namibia.

John Kinahan, Archaeologist

EXECUTIVE SUMMARY

Bannerman Resources plc proposes to construct a water pipe approximately 35kmin length, from the Base Pump Station located on the outskirts of Swakopmund, to a Terminal Reservoir at the Etango mine. The proposed route will largely follow an existing pipeline located in a corridor adjacent to the M0052 road. On the basis of existing data ten archaeological sites are likely to be affected by the construction of the pipeline. The sites are of low archaeological significance and it is recommended that the project is given consent to proceed. Additional ground survey was carried out to verify the current status of the sites. However, it is also recommended that the project adopt the attached Chance Finds Procedure in the event of encountering buried archaeological remains in the course of construction work.

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1. INTRODUCTION

1.1 Background

Bannerman Resources plc intends to construct a water supply pipeline from an existing Base Pump Station located on the outskirts of Swakopmund to the site of the proposed Bannerman Etango mine. The pipeline will be approximately 35km in length and will largely follow an existing pipeline corridor flanking the M0052 road. Developments such as the intended pipeline are listed in the Environmental Management Act (2007) as activities requiring environmental assessment and the issuance of an Environmental Clearance Certificate.

Archaeological remains in Namibia are protected under the National Heritage Act (2004) and National Heritage Regulations (Government Notice 106 of 2005), and ASEC cc, consultants to Bannerman Resources have appointed the undersigned, J. Kinahan, archaeologist, to carry out an assessment of the lease area on the basis of existing archaeological survey data. Additional ground survey was carried out to verify the current status of the sites.

1.2 Terms of Reference

The primary task of the archaeological assessment reported here was to identify sensitive archaeological/heritage sites that could be affected by powerline construction. The assessment forms the basis of recommended management actions to avoid or reduce negative impacts. The study is based on the results of a previous archaeological survey carried out in the same area and covering the footprint of the proposed powerline, with additional survey to verify the current status of the sites.[1]

1.3 Assumptions & Limitations

Archaeological assessment relies on the indicative value of surface finds recorded in the course of field survey. The results of previous field surveys in the same area may be used as a reliable basis for assessment. However, since the assessment is limited to surface observations and existing survey data, it is necessary to caution the proponent that hidden, or buried archaeological or palaeontological remains might be exposed as the project proceeds.

2. LEGAL REQUIREMENTS

The principal instrument of legal protection for archaeological/heritage resources in Namibia is the National Heritage Act (27 of 2004). Part V Section 46 of the Act prohibits removal, damage, alteration or excavation of heritage sites or remains. Section 48 *ff* sets out the procedure for application and granting of permits such as might be required in the event of damage to a protected site occurring as an inevitable result of development. Section 51 (3) sets out the requirements for impact assessment. Part VI Section 55 Paragraphs 3 and 4 require that any person who discovers an archaeological site should notify the National Heritage Council. Heritage sites

[1] QRS 139 *Archaeological field survey and assessment of the Swakop South water pipeline project.* Commissioned by EnviroDynamics cc, 15 June 2011.

or remains are defined in Part 1, Definitions 1, as "any remains of human habitation or occupation that are 50 or more years old found on or beneath the surface".

Archaeological/heritage impact assessment in Namibia may also take place under the rubric of the Environmental Management Act (7 of 2007) which specifically includes anthropogenic elements in its definition of environment. Activities that may not be undertaken without an Environmental Clearance Certificate: Environmental Management Act, 2007 (Govt Notice 29 of 2012), and the Environmental Impact Assessment Regulations: Environmental Management Act, 2007 (Govt Notice 30 of 2012) are subject to assessment of potential impacts on archaeological sites.

3. ARCHAEOLOGICAL SETTING & OBSERVATIONS

The central Namib Desert contains an exceptionally well preserved archaeological record of intermittent human occupation over the last one million years. Modern development including mining and the construction of related infrastructure has the potential to damage or destroy important archaeological evidence. Intensive mineral exploration resulting in the construction of several new uranium mines has been accompanied by a programme of detailed field survey to locate and identify archaeological sites that can be preserved or studied prior to their possible destruction. Over 320 such archaeological studies have been carried out in the last 20 years and the main results of these investigations have been published in an effort to improve public awareness and conservation of the archaeological record.[2]

In brief, the central Namib archaeological sequence comprises the following major units:

a. **Pliocene and early Pleistocene (ca. 10my to 0.128my; including OIS 6, 7, 19 &c):** represented by surface scatters of stone tools and artefact debris, usually transported from original context by fluvial action, and seldom occurring in sealed stratigraphic context.
b. **Mid- to upper Pleistocene (ca. 0.128my to 0.040my; OIS 3, 4 & 5a-e):** represented by dense surface scatters and rare occupation evidence in sealed stratigraphic context, with occasional associated evidence of food remains.
c. **Late Pleistocene to late Holocene (ca. 0.040my to recent; OIS 1 & 2):** represented by increasingly dense and highly diverse evidence of settlement, subsistence practices and ritual art, as well as grave sites and other remains.
d. **Historical (the last ca. 250 years):** represented by remains of crude buildings, livestock enclosures, wagon routes and watering points, as well as graves, comprising small cemeteries near farm settlements or isolated burial sites.

The alignment of the intended pipeline from the Base Pump Station on the outskirts of Swakopmund, to the proposed Bannerman Etango mine shown in Figure 1 is based relevant spatial data files supplied by the project

[2] Kinahan, J. 2020. *Namib, the archaeology of an African desert*. Windhoek: UNAM Press.

proponent. Figure 1 also shows the alignment of the intended pipeline in relation to the documented distribution of archaeological sites in the same area. A previous archaeological survey found a relatively low density of archaeological sites along the pipeline route. Additional ground survey carried out in the course of the present investigation did not locate any further archaeological sites. The ten sites previously documented are described below:

QRS 139/1
Position (WGS 84) Lat. -22.69973 Long.14.59292
Precision : 1
Setting: gravel plains
Description: isolated MSA flake, hornfels
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/2
Position (WGS 84) Lat. -22.69929 Long.14.59274
Precision: 1
Setting: gravel plains
Description: isolated MSA flake, hornfels
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/3
Position (WGS 84) Lat. -22.69738 Long.14.59178
Precision : 1
Setting: gravel plains
Description: chunk of yellow chert with cortex trimming
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/4
Position (WGS 84) Lat. -22.69288 Long.14.58947
Precision : 1
Setting: drainage line
Description: isolated MSA unifacial point, hornfels
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/5
Position (WGS 84) Lat. -22.68884 Long.14.58756
Precision: 1
Setting: gravel plains
Description: isolated MSA pebble tool, ?silcrete
Records: site notes, locality data, artefact collected
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/8
Position (WGS 84) Lat. -22.77121 Long.14.75487
Precision: 1
Setting: gravel plains
Description: isolated MSA unifacial point, hornfels
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/10
Position (WGS 84) Lat. -22.75431 Long.14.70667
Precision: 1
Setting: gravel plains
Description: isolated MSA core, hornfels
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/11
Position (WGS 84) Lat. -22.73309 Long.14.64724
Precision: 1
Setting: gravel plains
Description: isolated MSA unifacial point, ?silcrete
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/12
Position (WGS 84) Lat. -22.73180 Long.14.64381
Precision: 1
Setting: gravel plains
Description: isolated MSA unifacial point, hornfels
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

QRS 139/13
Position (WGS 84) Lat. -22.73120 Long.14.64269
Precision: 1s
Setting: gravel plains
Description: isolated MSA levallois unifacial point, hornfels
Records: site notes, locality data
Significance rating: 2
Vulnerability rating: 3/4

All of the sites are late Pleistocene Middle Stone Age artefacts with a Significance ranking of 2, indicating an "isolated minor find in undisturbed primary context, with diagnostic material", with a Vulnerability ranking of 3/4 indicating a "probable threat from inadvertent disturbance due to proximity of development" (3) or "high likelihood of partial disturbance or destruction due to close proximity of development" (4).

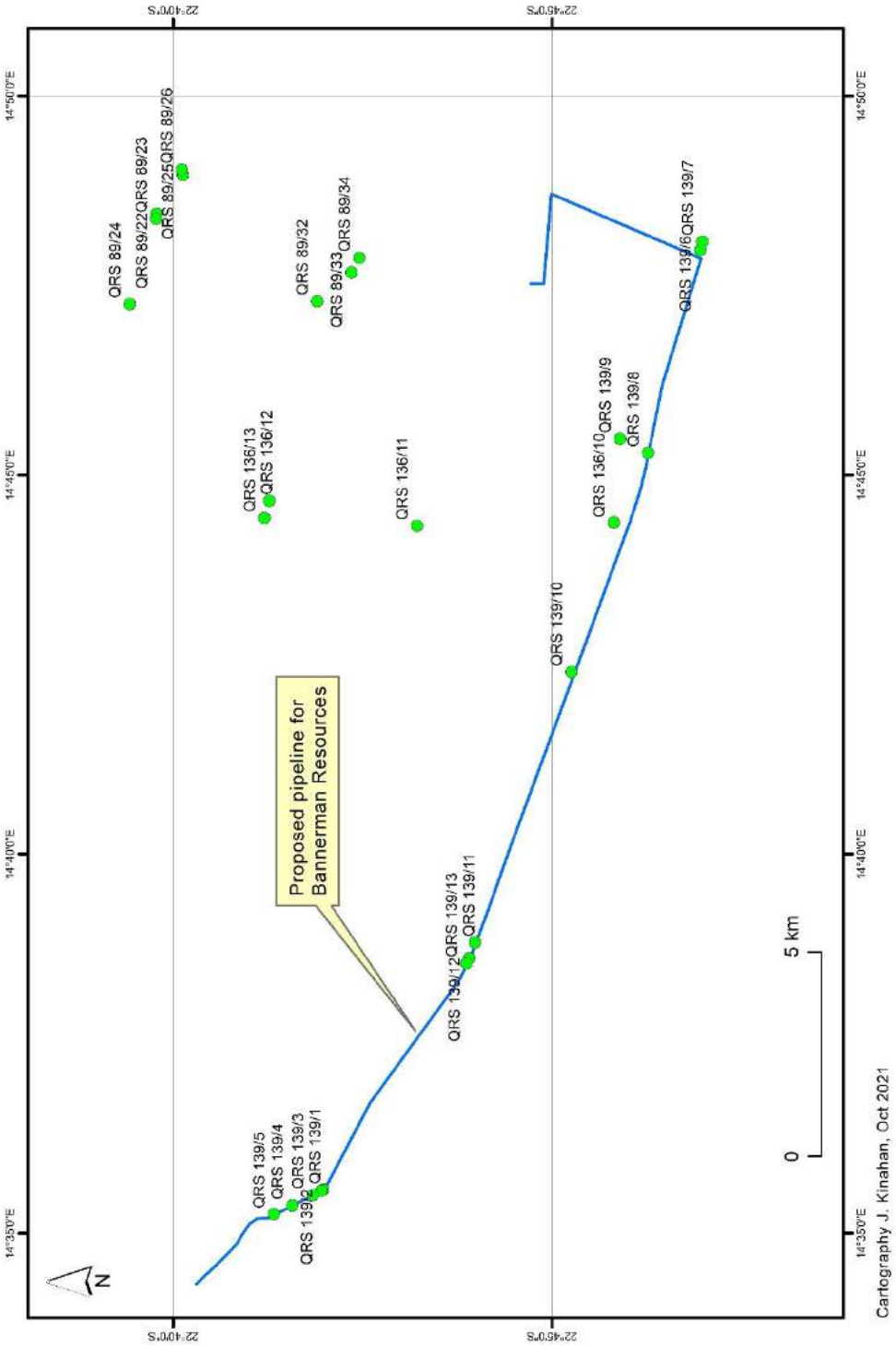

Figure 1: The archaeological setting of the proposed ppipeline.

4. IMPACT ASSESSMENT

The following archaeological impact assessment considers the intended pipeline route in relation to the results of a previous and comprehensive archaeological survey. The assessment employs the standard criteria of the environmental consultant ASEC cc. All of the ten archaeological sites likely to be affected by the intended pipeline construction lie directly within the existing pipeline corridor and are therefore likely to be disturbed or destroyed during construction. However, all of the sites are considered to be of low archaeological significance.

SIGNIFICANCE determination: Significance = consequence x probability

CONSEQUENCE Consequence is a function of the nature and intensity of the potential impact; Geographical extent should the impact occur; Duration of the impact.

Ranking the NATURE and INTENSITY of the potential impact

Negative impacts

Low (L) The impact has no / minor effect/deterioration on natural, cultural and social functions and processes. No measurable change. Recommended standard / level will not be violated. (Limited nuisance related complaints).

Moderate (M) Natural, cultural and social functions and processes can continue, but in a modified way. Moderate discomfort that can be measured. Recommended standard / level will occasionally be violated. Various third party complaints expected.

High (H) Natural, cultural or social functions and processes are altered in such a way that they temporarily or permanently cease. Substantial deterioration of the impacted environment. Widespread third party complaints expected.

Very high (VH) Substantial deterioration (death, illness or injury). Recommended standard / level will often be violated. Vigorous action expected by third parties.

Positive impacts

Low (L) + Slight positive effect on natural, cultural and social functions and processes Minor improvement. No measurable change.

Moderate (M) + Natural, cultural and social functions and processes continue but in a noticeably enhanced way. Moderate improvement. Little positive reaction from third parties.

High (H) + Natural, cultural or social functions and processes are altered in such a way that the impacted environment is considerably enhanced /improved. Widespread, noticeable positive reaction from third parties.

Very high (VH) + Substantial improvement. Will be within or better than the recommended level. Favourable publicity from third parties.

Ranking the EXTENT

Low (L) Local

Moderate (M) Regional

High (H) National

Very high (VH) International

Ranking the DURATION

Low (L) Temporary/short term. Quickly reversible. (Less than the life of the project).

Moderate (M) Medium Term. Impact can be reversed over time. (Life of the project).

High (H) Long Term. Impact will only cease after the life of the project.

Very high (VH) Permanent

Ranking the PROBABILITY

Low (L) Unlikely

Moderate (M) Possibly

High (H) Most likely

Very high (VH) Definitely

SIGNIFICANCE Description

Low (L) Supports the implementation of the project = Positive; No influence on the decision = Negative.

Moderate (M) Supports the implementation of the project = Positive; It should have an influence on the decision and the impact will not be avoided unless it is mitigated = Negative.

High (H) Supports the implementation of the project = Positive; It should influence the decision to not proceed with the project or require significant modification(s) of the project design/location, etc. (where relevant) = Negative.

Very high (VH) Supports the implementation of the project = Positive; It would influence the decision to not proceed with the project = Negative.

Following the impact assessment methodology, the main issue of concern here is the disturbance or destruction of ten late Pleistocene Middle Stone Age artefact occurrences and their landscape setting. The likelihood of such impacts is considered to be high. While the consequences of impacts to the

individual archaeological sites are considered to be moderate or low in terms of standard archaeological Significance and Vulnerability ranking, the combined impact on the archaeological landscape will be moderate. Implementation of the project will result in the very likely destruction or disturbance of ten archaeological sites associated with the intended pipeline construction.

In summary therefore, the archaeological impacts of the pipeline project are the potential or highly likely encroachment, disturbance and destruction of archaeological sites and their landscape setting. These impacts are considered to be NEGATIVE and rated as MODERATE/HIGH. Possibilities for mitigation of these impacts are limited and the impacts would not be reduced or altered to the point that they could be considered as POSITIVE. Since disturbance or destruction of archaeological sites cannot be reversed and is therefore always permanent, the duration of the impacts is considered to be VERY HIGH or permanent.

5. CONCLUSIONS & RECOMMENDATIONS

On the basis of the field survey data forming the basis of this desk assessment the proposed pipeline construction is not considered to pose a significant threat to the archaeology of the area concerned. Additional field survey conducted in the course of the present investigation did not locate any further archaeological sites. It is therefore recommended that the pipeline construction be granted consent to proceed. As a precaution however, it is recommended that the proponent should adopt the Chance Finds Procedure in Appendix 1 as part of the project Environmental Management Plan.

Appendix 1: Chance Finds procedure

Areas of proposed development activity are subject to heritage survey and assessment at the planning stage. These surveys are based on surface indications alone, and it is therefore possible that sites or items of heritage significance will be found in the course of development work. The procedure set out here covers the reporting and management of such finds.

Scope: The "chance finds" procedure covers the actions to be taken from the discovery of a heritage site or item, to its investigation and assessment by a trained archaeologist or other appropriately qualified person.

Compliance: The "chance finds" procedure is intended to ensure compliance with relevant provisions of the National Heritage Act (27 of 2004), especially Section 55 (4): *" a person who discovers any archaeological …. object ……must as soon as practicable report the discovery to the Council".* The procedure of reporting set out below must be observed so that heritage remains reported to the NHC are correctly identified in the field.

Responsibility:

Operator	To exercise due caution if archaeological remains are found
Foreman	To secure site and advise management timeously
Superintendent	To determine safe working boundary and request inspection
Archaeologist	To inspect, identify, advise management, and recover remains

Procedure:

Action by person identifying archaeological or heritage material

a) If operating machinery or equipment stop work

b) Identify the site with flag tape

c) Determine GPS position if possible

d) Report findings to foreman

Action by foreman

a) Report findings, site location and actions taken to superintendent

b) Cease any works in immediate vicinity

Action by superintendent

a) Visit site and determine whether work can proceed without damage to findings

b) Determine and mark exclusion boundary

c) Site location and details to be added to project GIS for field confirmation by archaeologist

Action by archaeologist

a) Inspect site and confirm addition to project GIS

b) Advise NHC and request written permission to remove findings from work area

c) Recovery, packaging and labelling of findings for transfer to National Museum

In the event of discovering human remains

a) Actions as above

b) Field inspection by archaeologist to confirm that remains are human

c) Advise and liaise with NHC and Police

d) Recovery of remains and removal to National Museum or National Forensic Laboratory, as directed.

Appendix I: Environmental Management Plan

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ENVIRONMENTAL MANAGEMENT PLAN

FOR

BANNERMAN MINING RESOURCES' PROPOSED NEW WATER PIPELINE FROM THE BASE PUMPSTATION NEAR SWAKOPMUND TO THE ETANGO PROJECT TURN OFF FROM THE C28 ROAD

FEBRUARY 2022

Compiled for:
Bannerman Mining Resources (Namibia) (Pty) Ltd
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Compiled by:
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PO Box 40386
Windhoek

1 INTRODUCTION

Bannerman Mining Resources (Namibia) (Pty) Ltd (Bannerman) has an Environmental Clearance Certificate (ECC2847) for the proposed mining and associated activities at the Etango Project. Bannerman appointed A. Speiser Environmental Consultants (ASEC) to conduct an Environmental Impact Assessment (EIA) process, including the development of an Environmental Management Plan (EMP) for the proposed water pipeline section from the NamWater base pump station near Swakopmund to the Etango Project turn off from the C28 Road (see **Figure 1**), as this had not been covered in the previous / approved EIA. The remaining section of the pipeline from the C28 Road to the Etango Project area has already been assessed and approved as part of the Etango EIA (Etango Project: Linear Infrastructure Environmental Impact Assessment, Environmental Impact Report (March /April 2011), Environmental Resources Management (ERM)) conducted between 2007 and 2008 and finalized in 2011 (ECC2847).

Power supply to the booster pump stations will come from the 22kV line to the north of the existing pipelines. A cable connected onto the overhead line – going down the pole and then buried in the corridor between the 22kV line and the substation which is located next to the pump station. …

This EMP documents a series of individual management plans which are designed to meet legal requirements and avoid or minimise the impacts associated with the construction and operation of specific pipeline section (and the power supply to the booster pumps stations).

The management plans have been compiled based on a review of the findings and recommendations of the EIA report for the proposed water pipeline section from the base pump station near Swakopmund to the Etango Project turn off from the C28 Road (ASEC, 2021).

1.1 Keeping EMPs up to date

It is the intention that this EMP should be seen as a “living document” which will be amended during the operation, as the activities might change or new ones be introduced.

1.2 Details of the Persons Who Prepared This EMP

ASEC, the independent firm of consultants who undertook the EIA has also compiled this EMP. Details of the Environment Assessment Practitioners are provided in the main (EIA) report.

2 LEGAL REQUIREMENTS

A summary of the applicable legislation can be found in **Section 5** in the main (EIA) report.

2.1 2.1 Permits and Rules

As stipulated in the EIA Regulations, No.30 of 2012, the Environmental Clearance Certificate (ECC) needs to be obtained from MEFT:DEA before the commencement of the Project.

Additional permits, which need to be in place and be obtained by Bannerman are -

Labour Act 11 of 2007:

Regulations relating to the health and safety of employees at work are contained in GN 156/1997 (GG 1617). Must be complied with on this project.

Forestry Act No 12 of 2001, Forest Amendment Act, No. 13 of 2005:

Section 22 of the Act requires a permit for the cutting, destruction or removal of vegetation that are classified under rare and or protected species. The Act also stipulates that trees, shrubs and bushes within 100 m from a watercourse may not be cut, destroyed or removed without a permit

National Heritage Act No 27 of 2004:

No archaeological/heritage site or cultural remains may be removed, damaged, altered or excavated. The Chance Find Procedure (see **Appendix H – Archaeology Specialist Study**) need to be applied should any additional remains be encountered.

Ten sites along the proposed pipeline corridor have been identified during the archaeological specialist study.

Park Rules:

The Parks rules need to be adhered to (see **Appendix 1**).

Environmental Quality Objectives (EQOs) from the Strategic Environmental Assessment 'Uranium Rush' (SAIEA, 2010):

The SEA sets out the likely cumulative impacts of mine-related developments in the Namib Naukluft National Park (NNNP), describes the 'desired state' that should be targeted by the various institutions and organizations involved and makes recommendations as to how this desired state can be achieved and maintained (SAIEA, 2010). The applicable EQOs are attached in **Appendix 2** of the EMP and are incorporated into the EMP. Where applicable the EQOs should be implemented.

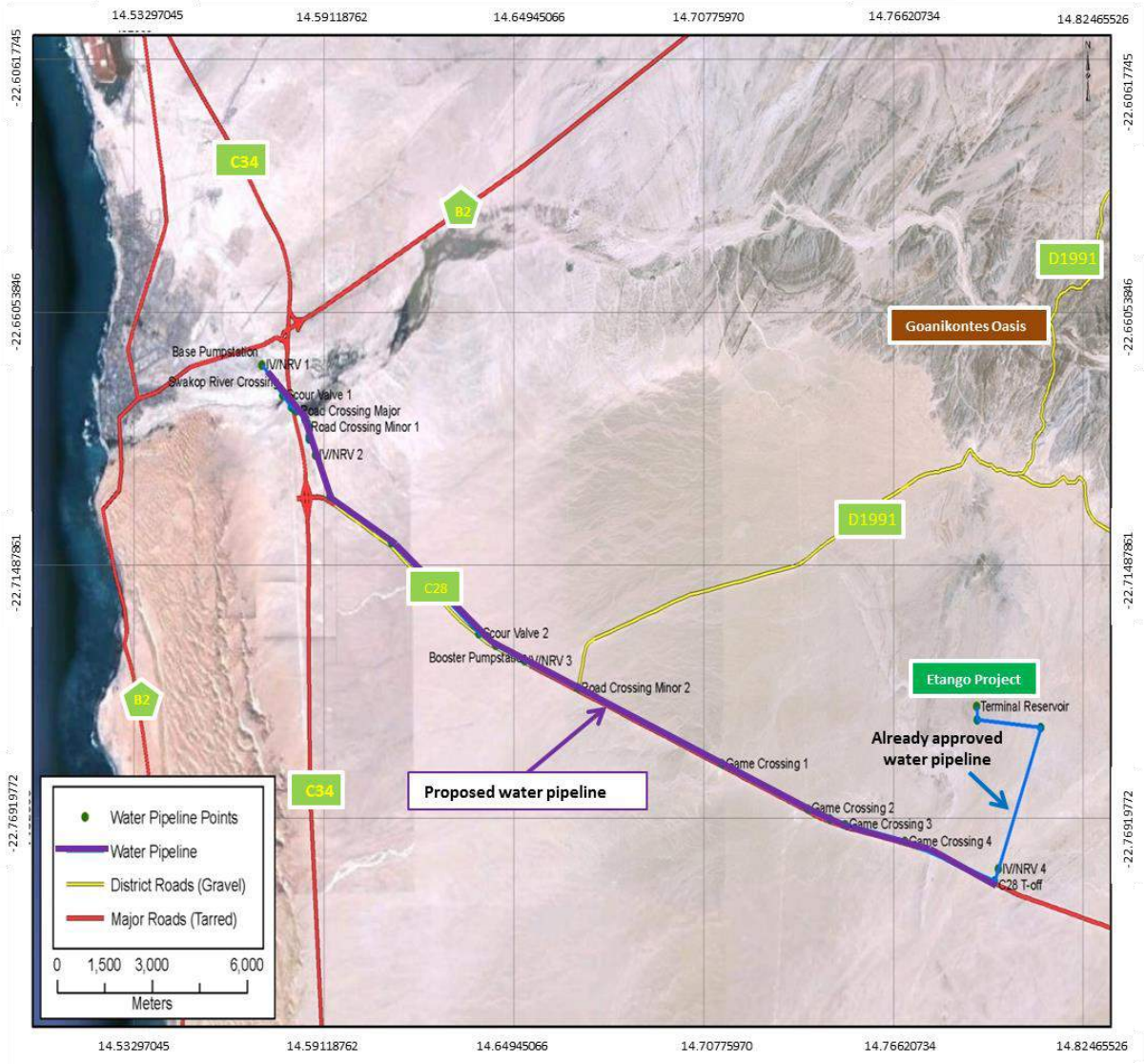

Figure 1: Location of the newly assessed water pipeline (purple) and already approved water pipeline (blue).

3 OVERALL ENVIRONMENTAL OBJECTIVES FOR THE EMP

The following overall environmental objectives have been set for the implementation of the proposed water pipeline Project.:

- To comply with national legislation and standards for the protection of the environment;
- To limit potential impacts on biodiversity through the minimisation of the footprint and the conservation of residual habitat as far as possible;
- To reduce cumulative impacts arising from a third water pipeline.
- To limit contaminated effluent discharge into the environment through the containment and recycling of contaminated water;

- To ensure the legal and appropriate management and disposal of general and hazardous waste, through the implementation of a strategy for the minimisation, recycling, management, temporary storage and removal of waste;
- To support and encourage environmental awareness and responsibility amongst all contractors;
- To ensure all employees and contractors adhere to the park rules;
- To ensure the all the contractors adhere to the relevant management commitments; and
- Ensure compliance to the EMP.

4 GENERAL MANAGEMENT REQUIREMENTS

The following sections list the general management requirements that are relevant to the construction activities of the proposed new pipeline. If approved by MEFT, the ECC for the water pipeline might in future be transferred to NamWater. The operations phase management requirements will then also be transferred to NamWater which would require an update of the EMP relating to the responsible parties.

4.1 Parties responsible for the implementation of the EMP

This section describes the roles and responsibilities for implementing the various management plans (refer to section 5).

4.1.1 Bannerman - Managing Director/ Project proponent

The Managing Director shall ensure compliance to this EMP. The EMP will be part of the contract with all contractors working on the project.

4.1.2 Bannerman – Construction Supervisor

The Construction Supervisor has overall responsibility for environmental management on the construction site for ensuring this EMP is implemented. To assist the Construction Supervisor, it is recommended to appoint an Environmental Officer (or dedicated person responsible for environmental management activities on site) who will be dedicated to managing and monitoring the environmental issues associated with the construction activities of the proposed pipeline.

The Construction Supervisor must ensure the EMP is included in all contracts and to ensure that contractors adhere to the conditions of the EMP, the ECC and other relevant permits.

Contract documents should consider the inclusion of penalties for non-conformance to the EMP, or to link the sign off of the Contract to a retainer clause. The client retains part of the contract fees until the Construction Supervisor has signed off the rehabilitated sites, indicating satisfaction with the rehabilitation of the Contractor's work and laydown area.

The Construction Supervisor shall be responsible for responding to any actual environmental emergencies / incidences that occur within their sections, or as specified in this procedure.

The Construction Supervisor shall also ensure that sufficient financial and human resources are available at short notice to implement emergency procedures, and to take corrective action pro-actively when environmental risks are evident in advance.

4.1.3 Environmental Officer

The Environmental Officer will be responsible for assisting the Construction Supervisor in all environmental issues, and specifically to ensure that the commitments as set out in this EMP are implemented during the construction phase. **Note:** After construction has been finalised the management and operation of the water pipeline will be handed over to NamWater.

In addition to the above, the Environmental Officer is responsible for ensuring that all persons involved during the construction comply with this EMP.

The Environmental Officer will be responsible for the following aspects related to compliance of this EMP:

- Regular inspections and auditing compliance to this EMP and any other relevant legal requirements e.g. permits and authorisations.
- Conduct environmental awareness training during induction training and on an ad hoc basis thereafter.
- Conduct scheduled monitoring as outlined in various sections in the EMP as well as any additional monitoring required by permit and authorisations issued to the water pipeline development by relevant authorities.
- Ensure compliance to this EMP and permits and authorisations issued to Bannerman by relevant authorities. Ensure responsibilities and target dates are developed for each one of the commitments in this EMP.
- Ensure compliance to the Park Rules by all employees and contractors through awareness training, engagement with MEFT: Directorate of Wildlife and National Parks (DWNP), where relevant.
- Submit required information to relevant authorities such as reporting related to monitoring and with regard to compliance with the EMP, permit and relevant authorisations.
- Liaise with the Construction Supervisor and Managing Director on environmental management (where required).

4.1.4 Contractors

All contractors and their sub-contractors and employees will be contractually required to comply with the relevant commitments in this EMP.

4.1.5 Auditing Compliance of the EMP

The commitments contained in this EMP will, once an ECC has been obtained, be Bannerman's contractual agreement with the Namibian authorities for sound environmental management. All employees, contractors and sub-contractors and any visitors to site will be expected to comply with the commitments contained herein.

4.1.5.1 Internal Audits and Inspections

The Environmental Officer will conduct internal management audits against the commitments in the EMP. These audits will be conducted every month. The audit findings will be documented for both record keeping purposes and for informing continual improvement.

The Environmental Officer will furthermore conduct daily inspections during construction.

4.1.5.2 External Environmental Performance Assessment

It is suggested that external performance assessments be conducted bi-annually and at the end of the construction phase by an independent qualified Environmental Practitioner.

4.1.6 Reporting / Submission of Information

As a minimum, the following documents will be submitted to the relevant authorities on an ongoing basis:

- The bi-annual environmental report required by the MEFT:DEA will be submitted every six months.
- Report any incidences relating to animals in the park to the MEFT.

5 ENVIRONMENTAL MANAGEMENT PLANS

5.1 Safety and security Management Plan

It is essential that safety and security measures are defined and implemented to ensure that the construction site cannot be accessed by unauthorized people.

Issue 1: General (third party) safety and security

- No unauthorized access to construction sites is allowed.

5.2 Flora Management Plan - Construction

Overall Issues and mitigation measures:

- Protect biodiversity
  - ✓ Use the map of lichen extent and washes to guide all planning decisions.
  - ✓ Protect lichen fields and washes from inadvertent disturbance.
  - ✓ Maintain ecosystem function by retaining natural water flow in all drainage lines and washes.
  - ✓ Prevent and control spread of invasive alien plants.
  - ✓ Rehabilitate by closing excavated areas as soon as possible.
  - ✓ Test restoring lichen fields and biocrusts after construction has been finalised during the operational phase.
- Limit footprint
  - ✓ Limit concrete slabs and foundations to what is absolutely necessary.
  - ✓ Ensure machinery and vehicles move or park within existing disturbed service corridor.
  - ✓ Continue to liaise with Reptile Mineral Resources & Exploration to ultimately implement one (combined) water pipeline for the relevant section and not two additional pipelines – if possible.

5.1.1 Management Measures

Issue 1: Loss of vegetation, lichens and associated biota due to the building of the pipeline

Mitigation measures:

- Reconsider routing the pipeline south of the two existing pipelines, if possible. Liaise with relevant Stakeholders (i.e. Roads Authority).
- Construct the pipeline below ground as far as possible and bury deeper when crossing washes, if a decision is taken to bury the pipeline.
- Construct the pipeline in the already disturbed service corridor as far as possible.
- Demarcate lichen areas before construction, where these would be crossed by the pipeline(s).

- Minimise ground disturbance by stockpiling excavated material in disturbed areas inside service corridor and outside of more densely vegetated areas such as washes and drainage areas.
- Backfill excavated areas immediately upon laying of pipeline, if a decision is taken to bury the pipeline. Access material (i.e. excavated soil), not used, for back filling must be removed from site and disposed of at the landfill site or at the proposed WRDs at the mine.
- Implement special rehabilitation measures where lichen fields are affected. These are:
  - ✓ Harvest lichens, lichen-covered rocks and top 1 cm of soil and store as inoculating medium for restoration.
  - ✓ Strip remaining topsoil (1-10 cm depth) where excavations are necessary, and
  - ✓ store nearby in disturbed area.
  - ✓ Re-apply topsoil on disturbed, but rehabilitated areas and inoculate with salvaged lichen and biocrust material.
  - ✓ Select some of these rehabilitated areas for monitoring the effect of topsoil application and inoculation on lichen and microphytic crust recovery.
  - ✓ Include selected sites in environmental monitoring programme for the future Etango Project.

Issue 2: Effect of dust on vegetation and lichens

Mitigation measures:

- Prevent dust generating activities during strong wind conditions.
- Use dust suppression measures (i.e. water sprays) when excessive dust is generated (visual inspection required). .

Issue 3: Introduction of invasive alien plants

Mitigation measures:

- Ensure that no material (e.g. building sand) from alien-infested sites are brought on site - Clean underbody and tyres of machinery that was in contact with alien-infested areas
- Monitor sites where additional water could potentially lead to the establishment of invasive alien plants (e.g. where leaks occurred).
- Eradicate emerging invasive alien plants.

5.3 Flora Management Plan – Operation

Issue 1: Change of habitat

Mitigation measures:

- Bury pipeline deeper in washes and drainage areas to avoid obstructing water flow and damage by floods (if a decision is made to bury the pipeline)

Issue 2: Introduction of invasive alien plants

Mitigation measures:

- Regularly check for leaks
- Monitor sites for invasive alien plants along pipeline and
- Eradicate immediately

5.4 Fauna Management Plan

Issue 1: Vertebrate fauna habitat affected; open trench a pitfall trap and above ground pipeline would affect ungulate and ostrich movement.

Mitigation measures:

- Mimic the "wildlife crossing" points along the existing pipelines – i.e. follow the same pipeline corridor;
- Leave enough space between the pipelines for maintenance purposes;
- Bury pipeline, where possible (depending on geology), from T/Off north-eastwards to the Terminal Reservoir area; and
- Avoid leaving an open trench overnight and/or leave access routes at each end of the trench, if the pipeline will be belowground.

5.5 Fauna Management Plan – Operation

Issue 1: Above ground pipeline would affect ungulate and ostrich movement.

Mitigation measures:

- Mimic the "wildlife crossing" points along the existing pipelines – i.e. follow the same pipeline corridor**.**

Issue 2: Fauna movement

- Set up a monitoring programme in conjunction with the other relevant Uranium Mining Companies (Swakop Uranium, Langer Heinrich and Reptile Mineral Resources & Exploration) along the water pipeline corridor to verify the effectiveness of the "wildlife crossing" points.
- Depending the monitoring results, improve / expand the crossing points, in consultation with MEFT (DNPW).

5.6 Archaeology Management Plan

Issue 1: Chance Find Procedure

Mitigation Measures

The Chance Find Procedure (see **Appendix H – Archaeology Specialist Study**) covers the actions to be taken from the discovery of a heritage site or item, to its investigation and assessment by a trained archaeologist or other appropriately qualified person.

Action by person identifying archaeological or heritage material:

- If operating machinery or equipment - stop work;
- Identify the site with flag tape;
- Determine GPS position if possible; and
- Report findings to foreman.

Action by foreman:

- Report findings, site location and actions taken to superintendent; and
- Cease any works in immediate vicinity.

Action by Construction Supervisor / Environmental Officer:

- Visit site and determine whether work can proceed without damage to findings;
- Determine and mark exclusion boundary; and
- Site location and details to be added to project GIS for field confirmation by archaeologist.

Action by archaeologist:

- Inspect site and confirm addition to project GIS;
- Advise NHC and request written permission to remove findings from work area; and
- Recovery, packaging and labelling of findings for transfer to National Museum.

5.7 Surface Water Management Plan

Issue 1: Pollution of surface water

Mitigation Measures

- Do no place any hydrocarbons in or near drainage lines
- Implement containment and clean-up measures relating to hazardous substance spillages (including hydrocarbons)
- All materials, fuels and chemicals will be collected, safely stored in sealed drums on impermeable surfaces within bunded and secured areas. These areas will be designed to contain 110% of the volume of one or the largest (in a multi drum setup) drum and will be equipped with traps and oil separators to contain spilled hydrocarbons. The used hydrocarbon liquid waste will be provided to third parties for recycling. Related records will be kept.
- All hazardous chemicals (new and used) and dirty water are handled in a controlled manner (e.g. handled over drip-trays) so that they do not contaminate surface water run-off and soil.
- All vehicles and machines must be maintained properly to ensure that oil spillages are kept at a minimum.
- Spill trays must be provided if refuelling of construction vehicles is done on site.
- Chemical sanitary facilities must be provided for construction workers. Construction workers should only be allowed to use temporary chemical / permanent toilets on the site. Chemical toilets shall not be within close proximity of any drainage system. Frequent maintenance should include removal without spillages.
- Maintain and implement spill management procedure, including the clean-up of hydro-carbon spills.

- Ad hoc spills will be cleaned up/remediated immediately in line with spillage management procedure.
- Place spill kits in all areas where hazardous substances are dispensed and stored and train staff to use it.

5.8 Air Quality Management and Mitigation Plan

Issue 1: Dust generation

Mitigation Measures:

- Minimize dust by using water sprayers in sensitive areas, e.g. lichens.

5.9 Soil Management Plan

Issue 1: Soil disturbance/ management

Mitigation Measures:

- Utilize as much as possible already disturbed areas.
- Limit the disturbance of soils to what is absolutely necessary both in terms of access tracks, laydown areas.
- In areas where the pipeline might be buried, the topsoil needs to be stored separately to put on the filed in area on top.
- All soil which cannot be refilled needs to be moved from site and deposed at an appropriate site (i.e. landfill site or at the proposed WRDs at the mine).

5.10 Visual Management Plan

Issue 1: Aesthetics or visual impacts

Mitigation Measures:

- Pipeline colour should match the surrounding colours of the desert.
- Construct the pipeline as close as possible to the exiting two pipelines, within the same corridor.

5.11 Solid & Liquid Waste management Plan

General aspects:

- Designated waste containers will be established along the construction route. Receptacles must have lids to prevent wind borne litter, or scavenging by animals.
- Recyclable waste will be sent to a reputable recycling company. The remainder of the waste will be disposed at a licenced landfill site off site
- Non-recyclable waste will be collected and taken to an off-site waste facility.
- Keep record of safe disposal of waste.

Issue 2: Collection, storage and disposal of hazardous waste

Mitigation Measures:

- Designated waste collection points will be established on site for hazardous waste..
- Hazardous waste will be disposed of at a permitted hazardous waste disposal site (Walvis Bay).
- Keep record of safe disposal of waste.

Appendix 1 – Parks Rules

It is against the law to:

a) Be in possession of an unsealed or loaded firearm;

b) Bring into the Park any pets, domestic or otherwise;

c) Leave a rest camp before sunrise or reach it after sunset, or cross the borders of the Park between sunset and sunrise;

d) Make fires at places other than the officially designated fire-places or make excessively large fires;

e) Stay overnight at any place other than a rest camp;

f) Throw away burning or smouldering objects or leave them at places where they may ignite something;

g) Drive at places other than roads marked by official road signs;

h) Kill, injure or needlessly disturb any wild animal;

i) Pick, collect, uproot or disturb any flower, shrub, herb or any other plant;

j) Damage or spoil any object in the park;

k) Leave the rest camp in any other way than in a vehicle, or leave or hang out from the vehicle in any other place than in a rest camp or an assigned camping site;

l) Throw away refuse or rubbish, except at places or in the receptacles provided for the purpose;

m) Make a noise which may disturb other people;

n) Drive or park in the Park in such a way that it may constitute a nuisance, disturbance or inconvenience to other people, or drive faster than the official speed limit;

o) Enter the Park in an open vehicle or on a deck of a motor truck not fitted with a grid cage or other effective protection;

p) Ignore the lawful instructions of MET Park officials;

q) To hitch-hike;

r) To use the tourists' facilities, i.e. swimming pool, etc. Park warden/ official need to be notified for any new drilling activities.

The visit/work to this Park is at your own risk and the Ministry of Environment and Tourism will not be held liable for any injuries, damage or losses you or your possessions may sustain.

All other park rules and regulations must be adhered too.

Appendix 2 – Applicable Environmental Quality Objectives (EQOs) from Geological Survey of Namibia (2020): Strategic Environmental Management Plan (SEMP) for the Central Namib Uranium Mining Province, 2018-2019 Report. Ministry of Mines and Energy, Windhoek, Republic of Namibia

EQO 4. WATER

Aims of this EQO:

To ensure that the public have the same or better access to water in future as they have currently, and that the integrity of all aquifers remains consistent with the existing natural and operational conditions (baseline). This requires that both the quantity and quality of groundwater are not adversely affected by prospecting and mining activities.

Desired Outcome 4.1.	Water for urban and rural communities is of acceptable quality.
Target 4.1.1.	Uranium mining does not compromise community access to water of appropriate quality.
Indicator 4.1.1.1.	Potable water conforms to minimum required quality as prescribed in the national water quality standards.

Desired Outcome 4.2.	The natural environment, urban and rural communities have access to adequate water.
Target 4.2.1.	Uranium mining does not compromise surface and groundwater availability.
Indicator 4.2.1.1.	Groundwater abstraction from NamWater's Central Namib water scheme does not exceed the aquifers' sustainable yield.

Desired Outcome 4.3.	Water for industrial purposes is available and reliable.
Target 4.3.1.	Additional water resources (notably desalinated water) are developed to meet industrial demand.
Indicator 4.3.1.1.	Industrial investors are not lost because of water unavailability.

EQO 5. AIR QUALITY

Aims of this EQO:

Workers and the public do not suffer significant increased health risks as a result of exposure to dust emission from the uranium mines.

Desired Outcome 5.2.	**Nuisance dust resulting from uranium mining is within acceptable thresholds.**
Target 5.2.1.	**Dust fallout levels at residences in towns should not exceed the recommended limit of 600 mg/m2/day.**
Indicator 5.2.1.1.	**Dust fallout levels in relevant towns are monitored continuously.**

EQO 7. EFFECT ON TOURISM

Aims of this EQO:

- The natural beauty of the desert and its sense of place are not compromised unduly by uranium mining; and to identify ways of avoiding conflicts between the tourism industry and prospecting/ mining, so that both industries can coexist in the Central Namib.
- Uranium mining does not prevent the public from visiting the usually accessible areas in the Central Namib for personal recreation and enjoyment; and to identify ways of avoiding conflicts between the need for public access and mining.

Desired Outcome 7.1.	Central Namib is accessible to the public (within the regulations of the National Parks).
Target 7.1.1.	Uranium mining does not result in net loss of publicly accessible areas.
Indicator 7.1.1.1.	Areas of importance for recreation that are not yet alienated by mining or prospecting are declared 'red flag' for prospecting or mining. These include: The Walvis-Swakop dunes, Messum Crater, Spitzkoppe (Gross and Klein), Brandberg, the Ugab, Swakop, Khan, and Kuiseb rivers, the coastal area between the Ugab River mouth and the tidal mud banks south of Sandwich Harbour (between lower mark and the main coastal road), the Welwitschia Drive and Park campsites.

Desired Outcome 7.2.	Uranium mining does not significantly reduce the visual attractiveness of the Central Namib.
Target 7.2.1.	Direct and indirect visual scarring from uranium mining is avoided or kept within acceptable limits.
Indicator 7.2.1.1.	Tour operators continue to regard areas such as the dunes, the coastline, Moon Landscape, Welwitschia Flats, Swakop and Khan River areas, and Spitzkoppe as a 'significant' component of their tour package.

EQO 8. ECOLOGICAL INTEGRITY

Aims of this EQO:

The ecological integrity and diversity of fauna and flora of the Central Namib is not compromised by uranium mining. Integrity in this case means that ecological processes are maintained, key habitats are protected, rare and endangered and endemic species are not threatened. All efforts are taken to avoid impacts to the Namib and where this is not possible, disturbed areas are rehabilitated and restored to function after mining/development.

Desired Outcome 8.1.	The ecological integrity of the Central Namib is maintained.
Target 8.1.1.	The mining industry and associated service providers avoid impacts to biodiversity and ecosystems, and where impacts are unavoidable, minimisation, mitigation and/or restoration and offsetting of impacts is achieved.
Indicator 8.1.1.1.	Important biodiversity areas [red or yellow flag areas] are taken into consideration when adjudicating prospecting and mining applications.
Indicator 8.1.1.5.	Sensitive areas are identified by mines and disturbance of these areas is minimized.
Indicator 8.1.1.6.	Infrastructure corridors are carefully planned to avoid ecologically sensitive areas, and demonstrate: - consideration of alternatives, - optimization of service provision; and - commitment to the 'green route'
Indicator 8.1.1.7.	Mines share infrastructure as much as possible, thus minimizing infrastructure proliferation.

Indicator 8.1.1.8.	Infrastructure planning and investment takes into account future demand, thus reducing the need for additional impacts.

Desired Outcome 8.5.	Water quality and quantity does not decrease to the extent that it negatively affects biodiversity.
Target 8.5.1.	Water table levels, and water quality standards are described, and ephemeral river ecosystems are monitored to ensure that these standards are not compromised.
Indicator 8.5.1.1.	Regular monitoring of indicator species in relevant ephemeral rivers is in place to detect

EQO 11. HERITAGE

Aims of this EQO:

Uranium exploration and mining and related infrastructure developments will have the least possible negative impact on archaeological and paleontological heritage resources. Survey, assessment and mitigation will result in significant advances in knowledge of archaeological and paleontological heritage resources, so that their conservation status is improved and their use in research, education and tourism is placed on secure and sustainable footing.

Desired Outcome 11.1.	The integrity of archaeological and paleontological heritage resources is not unduly compromised by uranium mining.
Target 11.1.1.	Mining industry and associated service providers avoid impacts to archaeological resources, and where impacts are unavoidable, mitigation, restoration and /or offsetting are achieved.
Indicator 11.1.1.1.	All mining and related developments are subject to archaeological and paleontological assessment No unauthorised impact occurs
Indicator 11.1.1.2.	Mining companies adhere to local and international standards of archaeological assessment**.**